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

2023-2025 cohort

Art. 1 Premise and scope

These Regulations, in accordance with the Statute and the University Didactic Regulations (general part and special part), discipline 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 Regulations of the Master's degree course in Bioengineering are approved, pursuant to article 25, sections 1 and 4 of the University Didactic Regulations, general part, by the Bioengineering Degree Programme Board (DPB) by the majority of the members and approved by the 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 DPB can also be taken in telematic modality according to the above-mentioned regulations and, in particular, of Article 14 "Meetings in telematic modality" of the current General Regulations 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 individual preparation.

The curricular requirements necessary to enroll in the Master's degree course are indicated in the Degree Regulations and must be acquired and verified before enrolment.
In order to enroll in the Master's Degree in Bioengineering, candidates must possess skills that are equivalent to those typically provided in Bachelor's degree programs in Information Engineering (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 Degree or Master's 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;

- **possession of at least 36 ECTS**, or equivalent knowledge, acquired during any university course in the disciplines indicated for the basic learning activities required by Class L-8 Information Engineering Degrees;
- **possession of at least 45 ECTS**, or equivalent knowledge, acquired during any university course in the disciplinary-scientific sectors (SSD) 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 and Information Technologies
- Computer Engineering

In the case of possession of degrees other than those indicated in the didactic system of the course, the DPB will verify the presence of the curricular requirements or equivalent knowledge, on the basis of the transcript of exams of their Degree 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 considering the appropriate equivalence between the successfully attended courses and the courses assigned to the above indicated SSD.

Adequate knowledge of the English language is also required, not lower than CEFR B2 or an equivalent level. This requirement is immediately accredited to all students who can exhibit a certificate attesting such level of knowledge, and to all those who have got their high school degree from an Italian institution (Decreto Legislativo N. 226 del 17 ottobre 2005, Art. 5 e All. D) and have obtained a first level academic qualification containing an English language exam or, in the case of students with a foreign high school degree, to those who have obtained a bachelor's degree where all the courses were taught in English.

The individual preparation is assessed on the basis of the student's academic performance with reference to their Bachelor's degree, be it Italian or foreign, or the qualification accepted as equivalent when evaluating curricular requirements.

The preparation is assessed as adequate if the weighted average of the marks is equal to or greater than 22.5/30 or if the Cumulative Grade Point Average (CGPA) is equal to at least 75% of the maximum score achievable at the university where the degree was obtained.

For international students, the academic reputation of the university which awarded the degree will also be evaluated, by referring to internationally recognized ranking such as Webometrics.

As a first application of this criterion (2023-2025 cohort), students who graduated in Italy but do not meet the individual preparation requirements can – upon their request – take an entrance exam which aims at ascertaining the candidate's actual general preparation, with particular reference to basic engineering notions 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 Degree Programme Coordinator and cannot be taken more than twice by each candidate within one academic year. The outcome of the test will only be a "pass" or a "fail".

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. Candidates must register for the test on the Aulaweb site dedicated to the admission to the course.

All students whose degree was obtained abroad will be assessed on their knowledge of the Italian language, by means of a test carried out by the University's School of Italian Language and Culture, in order to ascertain the student's possession of level B2 of the CEFR (Common European Framework of Reference for Languages).

Failing the exam will not prevent enrolment, but will make it necessary for the student to include an Italian language exam in their study plan.

For candidates from non-EU countries residing abroad and holding 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 'not eligible'.

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 these regulations.

One professor is appointed in charge of each teaching unit. The professor in charge of a course is the one who holds it according to the law, that is, the one to whom the Department Board has assigned that responsibility when allocating teaching tasks to professors..
A list of courses and all other activities that can be activated in cohorts 2023-2025 can be found as an annex to these regulations.

All training activities (lessons, exercises, workshops) will be held in English.

Art. 4 Enrollment in individual training activities

It is possible to enroll 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) both in English:

Track T1: Neuroengineering
- Curriculum T1C1: Neuroengineering and neurotechnologies
- Curriculum T1C2: Rehabilitation engineering and interaction technologies

Track T2: Engineering for Personalized Medicine
- 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 application 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 assays 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.

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 creation 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 and skills 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.

Art. 6 Total time commitment

The definition of the hourly fraction dedicated to lessons or equivalent teaching activities is established, for each teaching unit, by the DPB and is specified in the special part of these regulations (Annex 1). In any case the following intervals of variability of the correspondence between classroom/ECTS hours are assumed: 8 ÷ 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 these regulations.
The director of the DIBRIS Department and the DPB 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 current year Degree Programme Table. 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.
Students can include in the study plan for their first year one of the following teaching activities:
- 106729 BIOENGINEERING OF HUMAN MOVEMENT (NEUROENGINEERING AND NEUROTECHNOLOGIES track)
- 106739 NEURAL SIGNAL ANALYSIS (REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES track).

if they are listed as elective activities in their curriculum of choice.
Under no circumstances will it be possible for students to include second-year mandatory teaching units in their first year plan.

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 these regulations (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 Degree Programme website on the "Students" page.

Students who have completed their study plan 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 teaching methods

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.

Halfway through 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 Degree Programme 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 year Degree Programme Table.

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 Exams and other assessment tests

Exams 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 Degree Programme website.
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 Didactic 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 preparation, which cannot, regardless, be divided into separate assessments of individual modules.

The calendar of 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 calendar of potential in-course tests is established by the DPB and communicated to the students at the beginning of each teaching cycle.

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

All the exams and assessment tests related to the learning 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 Degree Programme website.

The outcome of the exam, along with the mark 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 Degree Programme Coordinator and are composed of at least 3 members. At least 2 members will be present at each exam session. The coordinating lecturer for the teaching is a member with the function of president. The members of the commission must be experts in the subject identified by the Degree Programme Board 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. Upon appointment of each commission, at least one substitute president must be identified. In each exam session, the commissions are chaired by the president or by a substitute.

Art. 10   Recognition of credits

The DPB decides on the approval of transfer applications from another Degree Programme of the University or from other universities, according to the norms of the University Didactic Regulations, art. 18. It also decides on the recognition as credit, for up to 12 ECTS, of professional knowledge and skills certified according to the regulations in force. In the evaluation of the applications for transfer, the didactic specificities and the topicality of the training contents of the single exams taken by the student will be taken into account, reserving the right to establish possible forms of verification and integrative exams on a case-by-case basis.

Art. 11   Mobility, studies abroad, international exchanges

The DPB 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 regulations 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 DPB 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, which 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, when compiling the plan of educational activities that they intend to follow in the foreign university, students must 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 DPB.

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

For periods of study dedicated to the preparation of the final exam, the number of credits recognized to that end 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 thesis, 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 must be from the DPB and/or the Department of reference (DIBRIS) and/or from other departments of the Polytechnic School.

The thesis offers are published on 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 must be written in English and must be completed by a title and a comprehensive summary in Italian.

The thesis must 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 work 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 Programme, 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 Degree Programme Coordinator.

The procedure for the final exam 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 thesis is presented and defended in English.

If the final exam is successfully passed, its evaluation by the Committee is made by assigning from a minimum of 0 to a maximum of 6 points, as established by the Polytechnic School in agreement with the Departments and reported in the current year Degree Programme Table, to the weighted average of the grades obtained in the tests for learning activities require a final grade, taking as weight the number of credits associated with each learning activity. The maximum grade is 110.

The Commission, with a unanimous vote, may award honors ("Lode") to students whose theses are considered of exceptional quality and who, on the basis of the increases mentioned in the previous paragraphs, have 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 requires a peer-review of the manuscript, and officially accepted before the time of the defense.

The Degree Programme recognizes credits for theses 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 credits are attributed to the final exam (thesis). For each month spent abroad for the thesis project, 4 ECTS are recognized. As an example, a 3-month stay abroad of would correspond to the recognition of 12 ECTS, while a period of 6 months or more would correspond to the recognition of 24 ECTS.

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 DPB recognizes the non-obsolescence of the related educational contents.

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

Once the required tests have been passed, the DPB 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 Current year Degree Programme Table

The DIBRIS Department, after consulting with the Polytechnic School, approves and publishes annually the Study Manifesto onto the University website and accessible from degree programme. In the Manifesto are indicated the main provisions of the didactic system and the teaching regulations 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.

Approved by resolution of the Degree Programme Board on 26th April 2023 and of the DIBRIS Department Board on 16th May 2023

DEGREE REGULATION - Special part

Curriculum (Path)	Academic year	Code	Name	ECTS	SSD	Type	Area	Language	Training objectives	Hours reserved to assisted teaching activities	Hours reserved to individual study
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CORE	Biomedical engineering	English	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	9	ING-INF/06	CORE	Biomedical engineering	English	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	80563	ANALYSIS OF BIOMEDICAL DATA AND SIGNALS	9	ING-INF/06	CORE	Biomedical engineering	English	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	9	ING-INF/06	CORE	Biomedical engineering	English	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	7	ING-INF/06	CORE	Biomedical engineering	English	A consistent and up-to-date introduction to basic facts and theories regarding human sensory perception. The teaching covers the physical and physiological aspects of each sensory modality and its perceptual characteristics. Emphasis is given on how perceptual experience relates to the physical properties of the external world, the characteristics of sensory signals, and the architectural	56	119

									principles of the nervous system.		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80564	PERCEPTUAL SYSTEMS AND INTERACTION	7	ING-INF/06	CORE	Biomedical engineering	English	A consistent and up-to-date introduction to basic facts and theories regarding human sensory perception. The teaching covers the physical and physiological aspects of each sensory modality and its perceptual characteristics. Emphasis is given on how perceptual experience relates to the physical properties of the external world, the characteristics of sensory signals, and the architectural principles of the nervous system.	56	119
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	9		RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	9		RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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	9		RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80585	CHEMISTRY AND BIOCHEMISTRY	9		RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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 COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM/07	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM/07	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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	40	85

									considers, and on the discussion of structure/properties relationship of synthetic and natural macromolecules.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM/07	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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	5	CHIM/07	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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	4	BIO/10	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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 design/implementation 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 integration between the different human organs.	32	68

| MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE | 1 | 80587 | MOD. 2 BIOCHEMISTRY | 4 | BIO/10 | RELATED OR SUPPLEMENTARY | Related or supplementary learning activities | English | 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 design/implementation 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 integration between the different human organs. | 32 | 68 |

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80587	MOD. 2 BIOCHEMISTRY	4	BIO/10	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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 design/implementation 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 integration between the different human organs.	32	68

| REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES | 1 | 80587 | MOD. 2 BIOCHEMISTRY | 4 | BIO/10 | RELATED OR SUPPLEMENTARY | Related or supplementary learning activities | English | 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 design/implementation 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 integration between the different human organs. | 32 | 68 |

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	86744	BIOMEDICAL ROBOTICS	6	ING-INF/06	CORE	Biomedical engineering	English	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 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.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	86744	BIOMEDICAL ROBOTICS	6	ING-INF/06	CORE	Biomedical engineering	English	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 second part is devoted to in-depth analysis of	48	102

									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.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	86744	BIOMEDICAL ROBOTICS	6	ING-INF/06	CORE	Biomedical engineering	English	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 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.	55	95

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	86744	BIOMEDICAL ROBOTICS	6	ING-INF/06	CORE	Biomedical engineering	English	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 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.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	3		OTHER	Further language knowledge	English	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.	36	39

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	3		OTHER	Further language knowledge	English	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.	36	39
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	3		OTHER	Further language knowledge	English	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.	36	39
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	3		OTHER	Further language knowledge	English	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.	36	39

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	OTHER	Training and orientation activities	English	Internship in the laboratory, focused on learning specific techniques pertinent to the choice path and on carrying out an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	OTHER	Training and orientation activities	English	Internship in the laboratory, focused on learning specific techniques pertinent to the choice path and on carrying out an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106729	BIOENGINEERING OF HUMAN MOVEMENT	6	ING-INF/06	CORE	Biomedical engineering	English	The course covers the technologies, the analytical methods, the modeling approaches used for the analysis 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.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.	48	102

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and	48	102

									experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106736	BIOMEDICAL IMAGING	6	ING-INF/06	CORE	Biomedical engineering	English	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	6	ING-INF/06	CORE	Biomedical engineering	English	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	6	ING-INF/06	CORE	Biomedical engineering	English	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	69	81

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106736	BIOMEDICAL IMAGING	6	ING-INF/06	CORE	Biomedical engineering	English	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	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CORE	Biomedical engineering	English	Definition of neural interfaces and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advanced signal processing for neural interfaces. Encoding and decoding of information in neural interfaces. Definition of unidirectional and bidirectional neural interfaces. Brain-machine interfaces and invasive and noninvasive neural prostheses for the central nervous system: current materials, methods, and applications	78	122
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CORE	Biomedical engineering	English	Definition of neural interfaces and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advanced signal processing for neural interfaces. Encoding and decoding of information in neural interfaces. Definition of unidirectional and bidirectional neural interfaces. Brain-machine interfaces and invasive and	64	136

									noninvasive neural prostheses for the central nervous system: current materials, methods, and applications		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106739	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	CORE	Biomedical engineering	English	The course aims to provide a critical analysis of the methods for analyzing the neuronal signal starting from the characterization of the single spike, to the activity of multiple cells up to the analysis of the electroencephalographic signal. The course will provide the basics to be able to manipulate, analyze and critically interpret the most common electrophysiological data	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATICS	6	ING-INF/06	CORE	Biomedical engineering	English	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 extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support	48	102

									advanced practitioners in the field.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATICS	6	ING-INF/06	CORE		Biomedical engineering	English	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 extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support advanced practitioners in the field.	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTEMS	6	ING-IND/34	CORE		Biomedical engineering	English	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 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.	55	95
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTEMS	6	ING-IND/34	CORE		Biomedical engineering	English	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 main concepts of microsystems applied to biomedicine and biotechnology, with emphasis on the scaling laws	55	95

									governing miniaturization, the fabrication techniques, and some specific aspects such as microfluidics and integration.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	2	ING-IND/34	OTHER	Training and orientation activities	English	Lab internship, focusing on learning specific skills pertinent to the track of choice, and on working on an individual project.	40	10
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	2	ING-IND/34	OTHER	Training and orientation activities	English	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	9	ING-IND/34	CORE	Biomedical engineering	English	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 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	72	153

										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	1	106753	TECHNOLOGIES FOR PERSONALIZED MEDICINE	9	ING-IND/34	CORE	Biomedical engineering	English	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 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	72		153

									and applicability of personal digital health.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		OTHER	Further language knowledge	Italian (English upon request)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		OTHER	Further language knowledge	Italian (English upon request)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		OTHER	Further language knowledge	Italian (English upon request)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		OTHER	Further language knowledge	Italian (English upon request)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80575	COMPUTATIONAL NEUROSCIENCE	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	80575	COMPUTATIONAL NEUROSCIENCE	6	ING-INF/06	CORE	Biomedical engineering	English	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	6	ICAR/01	ELECTIVE	Learning activities chosen by the student	English	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	6	ICAR/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL AND HEALTHCARE ENGINEERING	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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 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)	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL AND HEALTHCARE ENGINEERING	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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 AND HEALTHCARE ENGINEERING	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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 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)	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	80606	CLINICAL AND HEALTHCARE ENGINEERING	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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 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)	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	6	MED/42	ELECTIVE	Learning activities chosen by the student	English	To provide essential knowledge relating to: the concept of health, protection and promotion of health, health education; identification and control of the causes of disease and risk factors in the environment; including the epidemiology and prevention of the main infectious and chronic-degenerative diseases.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	6	MED/42	ELECTIVE	Learning activities chosen by the student	English	To provide essential knowledge relating to: the concept of health, protection and promotion of health, health education; identification and control of the causes of disease and risk factors in the	48	102

								environment; including the epidemiology and prevention of the main infectious and chronic-degenerative diseases.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84341	HOSPITAL ENERGY SYSTEMS	6	ING-IND/33	ELECTIVE	Learning activities chosen by the student	English	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	6	ING-IND/33	ELECTIVE	Learning activities chosen by the student	English	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).	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84341	HOSPITAL ENERGY SYSTEMS	6	ING-IND/33	ELECTIVE	Learning activities chosen by the student	English	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 COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84344	MASTER THESIS	25		FINAL EXAM	For the final exam	English	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	25		FINAL EXAM	For the final exam	English	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	0	625

									professional candidate, as well as his / her innovative capacity The candidate must also demonstrate that they have acquired analysis, processing and communication skills		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84344	MASTER THESIS	25		FINAL EXAM	For the final exam	English	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	25		FINAL EXAM	For the final exam	English	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

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84386	SPORTS BIOMECHANICS	6	ING-IND/12	ELECTIVE	Learning activities chosen by the student	English	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	6	ING-IND/12	ELECTIVE	Learning activities chosen by the student	English	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
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84386	SPORTS BIOMECHANICS	6	ING-IND/12	ELECTIVE	Learning activities chosen by the student	English	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 COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84391	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	6	INF/01	ELECTIVE	Learning activities chosen by the student	English	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 operationally apply the	42	102

									concepts learned in the virtual and augmented reality		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84391	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	6	INF/01	ELECTIVE		Learning activities chosen by the student	English	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 operationally apply the concepts learned in the virtual and augmented reality	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84391	SOFTWARE TECHNOLOGIES FOR HUMAN COMPUTER INTERACTION	6	INF/01	ELECTIVE		Learning activities chosen by the student	English	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	48	102

									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	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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, sensory substitution, neurorehabilitation and assistive technologies.	55	95
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	86775	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	6	ING-INF/06	CORE	Biomedical engineering	English	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	55	95

									of the most advanced techniques of functional assessment, prosthetics, sensory substitution, neurorehabilitation and assistive technologies.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	ELECTIVE	Learning activities chosen by the student	English	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 clinic and to research in the healthy subject and in neurological patients	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	ELECTIVE	Learning activities chosen by the student	English	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 clinic and to research in the healthy subject and in neurological patients	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	94827	MEDICAL TECHNOLOGIES FOR CLINICAL NEUROSCIENCE	6	MED/50	ELECTIVE	Learning activities chosen by the student	English	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 clinic and to research in the healthy subject and in neurological patients	48	90
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95614	COMPOSITE MATERIALS FOR BIO-MEDICAL APPLICATION	6	ING-IND/22	ELECTIVE	Learning activities chosen by the student	English	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	6	ING-IND/22	ELECTIVE	Learning activities chosen by the student	English	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	6	SECS-P/03	ELECTIVE	Learning activities chosen by the student	English	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

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	98288	HEALTH ECONOMICS	6	SECS-P/03	ELECTIVE	Learning activities chosen by the student	English	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	6	SECS-P/03	ELECTIVE	Learning activities chosen by the student	English	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
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	98288	HEALTH ECONOMICS	6	SECS-P/03	ELECTIVE	Learning activities chosen by the student	English	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	106728	PROFESSIONAL SKILLS	3	ING-INF/06	OTHER	Other work-oriented knowledge	English	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	24	51
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106728	PROFESSIONAL SKILLS	3	ING-INF/06	OTHER	Other work-oriented knowledge	English	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	37	38

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	3	ING-INF/06	OTHER	Other work-oriented knowledge	English	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	3	ING-INF/06	OTHER	Other work-oriented knowledge	English	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106729	BIOENGINEERING OF HUMAN MOVEMENT	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	The course covers the technologies, the analytical methods, the modeling approaches used for the analysis 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.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106730	CELLULAR AND TISSUE ENGINEERING	6	ING-IND/34	CORE	Biomedical engineering	English	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.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106730	CELLULAR AND TISSUE ENGINEERING	6	ING-IND/34	ELECTIVE	Learning activities chosen by the student	English	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 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.	48	102

| INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE | 2 | 106731 | DIGITAL HEALTH | 6 | ING-INF/06 | CORE | | Biomedical engineering | English | 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- 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. | 48 | 102 |

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106731	DIGITAL HEALTH	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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- 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.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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	6	INF/01	ELECTIVE	Learning activities chosen by the student	English	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	The course will introduce the fundamental concepts and principles of machine learning and artificial	48	102

									intelligence as it applies to medicine		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106734	ARTIFICIAL INTELLIGENCE IN MEDICINE	6	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	The course will provide a design guideline of neuromorphic models for the representation and distributed processing of multidimensional signals. The emphasis is on both computational primitives and architectural schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments are presented as case studies.	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106738	NEUROMORPHIC COMPUTING	6	ING-INF/06	CORE	Biomedical engineering	English	The course will provide a design guideline of neuromorphic models for the representation and distributed processing of multidimensional signals. The emphasis is on both computational primitives and architectural schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments are presented as case studies.	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106739	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	The course aims to provide a critical analysis of the methods for analyzing the neuronal signal starting from the characterization of the single spike, to the activity of multiple cells up to the analysis of the electroencephalographic signal. The course will	48	102

									provide the basics to be able to manipulate, analyze and critically interpret the most common electrophysiological data		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106740	NEUROSENSORY ENGINEERING	6	ING-INF/06	ELECTIVE	Learning activities chosen by the student	English	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 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	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106740	NEUROSENSORY ENGINEERING	6	ING-INF/06	CORE	Biomedical engineering	English	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 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	48	102

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106744	BIOMATERIALS	6	ING-IND/22	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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-chemical characterization methods like rheometry, calorimetry, surface enrgies, also focusing over the interactions within natural tissues.	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106744	BIOMATERIALS	6	ING-IND/22	ELECTIVE	Learning activities chosen by the student	English	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-chemical characterization methods like rheometry, calorimetry, surface enrgies, also focusing over the interactions within natural tissues.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English		0	0
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	ELECTIVE	Learning activities chosen by the student	English		0	0

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106758	INTERNET OF HEALTHCARE THINGS MOD. 2	3	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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 tolerance and replication, service oriented architectures platforms, embedded operating systems, real time and streaming data, geolocation, and collaborative framework.	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106758	INTERNET OF HEALTHCARE THINGS MOD. 2	3	INF/01	ELECTIVE	Learning activities chosen by the student	English	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 tolerance and replication, service oriented architectures platforms, embedded operating systems, real time and streaming data, geolocation, and collaborative framework.	24	51
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106824	WEARABLE DEVICES FOR BIOMEDICAL APPLICATIONS MOD. 1	3	INF/01	RELATED OR SUPPLEMENTARY	Related or supplementary learning activities	English	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	3	INF/01	ELECTIVE	Learning activities chosen by the student	English	This unit will cover the general principles for design and development of wearable devices for biomedical applications	24	51

								(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	6		ELECTIVE	Learning activities chosen by the student	English		0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108682	MECHANICS OF BIOLOGICAL TISSUE	6		ELECTIVE	Learning activities chosen by the student	English		0	0
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	ELECTIVE	Learning activities chosen by the student	English	The unit will provide the basic notions of mechanics of biological tissue and teach them how to formulate appropriate mathematical models. It will also provide notions on numerical analysis to find numerical solutions of the mathematical problems. One of the aims of the course is to teach the students how to work independently on a new project and how to find and study the existing scientific literature	24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	ELECTIVE	Learning activities chosen by the student	English	The unit will provide the basic notions of mechanics of biological tissue and teach them how to formulate appropriate mathematical models. It will also provide notions on numerical analysis to find numerical solutions of the mathematical problems. One of the aims of the course is to teach the students how to work independently on a new project and how to find and study the existing scientific literature	24	51

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING-IND/06	ELECTIVE	Learning activities chosen by the student	English	The unit will first introduce senses and sensory systems in living organisms with special focus on the biomechanics of one sensory system. We will build a mathematical model to study how organisms collect and process specfici sensory information from their surroundings. A main aim of the module is to develop the skills necessary for group work, learn how to critically read the literature, develop simple mathematical models that capture the fundamental ingredients of an open problem and assess its potential, limitations and potential improvements	24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING-IND/06	ELECTIVE	Learning activities chosen by the student	English	The unit will first introduce senses and sensory systems in living organisms with special focus on the biomechanics of one sensory system. We will build a mathematical model to study how organisms collect and process specfici sensory information from their surroundings. A main aim of the module is to develop the skills necessary for group work, learn how to critically read the literature, develop simple mathematical models that capture the fundamental ingredients of an open problem and assess its potential, limitations and potential improvements	24	51

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	111103	ARTIFICIAL INTELLIGENCE	6	ING-INF/05	ELECTIVE	Learning activities chosen by the student	English	The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the "deductive" side of the discipline. Students will learn basics in propositional and first order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action effects will be added on top of the basic capabilities for representation and reasoning.	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	111103	ARTIFICIAL INTELLIGENCE	6	ING-INF/05	ELECTIVE	Learning activities chosen by the student	English	The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the "deductive" side of the discipline. Students will learn basics in propositional and first order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action effects will be added on top of the basic capabilities for representation and reasoning.	48	102

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 2023-2025

Art. 1.   Premessa e ambito di applicazione

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 approvato, 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 curricolari e di adeguatezza della preparazione personale.

I requisiti curricolari necessari per l'iscrizione al corso di Laurea Magistrale sono specificati nell'ordinamento didattico del corso e devono essere acquisiti e verificati prima dell'immatricolazione.

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 curricolari:

- **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
- **conseguimento 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
- **conseguimento 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 curricolari richiesti dalla Laurea Magistrale in Bioengineering:

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

Nel caso di lauree differenti da quelle indicate nell'ordinamento didattico del corso, il CCS verificherà la presenza dei requisiti curricolari o delle conoscenze equivalenti, sulla base degli esami sostenuti dallo studente nel Corso di Laurea di provenienza, nonché la presenza di eventuali esami extra-curricolari, 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 curricolari 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 B2 o equivalente del Quadro comune europeo di riferimento per la conoscenza delle lingue.
Tale conoscenza è immediatamente riconosciuta a tutti coloro che esibiscano un certificato che attesti una conoscenza di tale livello e a tutti gli studenti che abbiano ottenuto un diploma di scuola superiore da un'istituzione italiana (Decreto Legislativo N. 226 del 17 ottobre 2005, Art. 5 e All. D) e abbiano ottenuto un titolo accademico di primo livello in cui fosse presente un esame di lingua inglese o, nel caso di studenti con un diploma di scuola superiore straniero, a tutti coloro che abbiano ottenuto un titolo di laurea triennale che prevedeva tutti i corsi erogati in inglese.

La preparazione individuale è valutata sulla base della performance accademica dello studente nell'ambito della laurea triennale, italiana o estera, o titolo giudicato equivalente in sede di accertamento dei requisiti curricolari.

La preparazione individuale è considerata adeguata se la media pesata dei voti è maggiore o uguale a 22.5/30 oppure se il Cumulative Grade Point Average (CGPA) è almeno pari al 75% del punteggio massimo ottenibile nell'università in cui è stata conseguita la laurea.
Nel caso degli studenti internazionali è inoltre valutata la reputazione accademica della sede di laurea, quantificata mediante ranking internazionalmente riconosciuti (es Webometrics).

In prima applicazione (coorte 2023-2025) di questo criterio, i laureati in Italia che non soddisfano i requisiti di preparazione individuale sono sottoposti a loro richiesta a un esame di ammissione che è finalizzato ad accertare la effettiva preparazione generale del candidato con particolare riferimento alle nozioni fondamentali dell'ingegneria e gli 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 nel corso di uno stesso anno accademico. L'esito della prova prevede la sola dicitura "superato", ovvero "non superato".

Nell'avviso per l'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. I candidati dovranno iscriversi alla prova nel sito Aulaweb dedicato all'ammissione al Corso.

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.

Il mancato superamento non impedirà l'iscrizione, ma comporterà la necessità di includere nel piano di studio un esame di lingua italiana.

Per i candidati provenienti da Paesi Extra EU, con residenza estera e in possesso di titolo di studio estero, la procedura di presentazione della 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 (credentials evaluation)
- • Valutazione del candidato

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

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 2023-2025, è riportato al termine del presente documento.

Tutte le attività formative (lezioni, esercitazioni, laboratori) si svolgono in lingua inglese.

Art. 4.   Iscrizione a singole attività formative
È possibile iscriversi 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 percorsi formativi (track), comprendenti ciascuno due indirizzi (curricula):

Track T1: Neuroengineering
- Curriculum T1C1: Neuroengineering and neurotechnologies
- Curriculum T1C2: Rehabilitation engineering and interaction technologies

Track T2: Engineering for Personalized Medicine
- 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.

Questo percorso formativo intende 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 indirizzi (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 percorso formativo intende 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.

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 ÷ 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. Uno fra questi insegnamenti
- BIOENGINEERING OF HUMAN MOVEMENT (106729);
- NEURAL SIGNAL ANALYSIS (106739),
se presente nel pacchetto a scelta del proprio curriculum, può essere anticipato al primo anno.
In ogni caso non è possibile anticipare al primo anno insegnamenti obbligatori previsti nel proprio curriculum nell'anno successivo.

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 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 deve essere redatta in lingua inglese e deve essere corredata da un titolo e 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 della tesi di laurea da parte dello studente alla Commissione, seguita da una discussione sulle questioni eventualmente poste dai Commissari.

La presentazione e la discussione della tesi si svolgono in lingua inglese.

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.

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 una validità di sei anni.
Trascorso tale periodo, 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.

Il presente Regolamento Didattico è stato approvato con delibere del Consiglio del Corso di Studi in Bioengineering il 26/04/2023 e del Consiglio di Dipartimento del Dibris il 16/05/2023

REGOLAMENTO DIDATTICO – Parte Speciale

Indirizzo	Anno di corso	Codice_ins	Nome_ins	CFU	SSD	Tipologia	Ambito	Lingua	Obiettivi formativi	Ore riservate attività didattica assistita	Ore riservate allo studio personale
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80563	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	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	80563	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	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	7	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	A consistent and up-to-date introduction to basic facts and theories regarding human sensory perception. The teaching covers the physical and physiological aspects of each sensory modality and its perceptual characteristics. Emphasis is given on how perceptual experience relates to the physical properties of the external world, the characteristics of sensory signals, and the architectural principles of the nervous system.	56	119

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80564	PERCEPTUAL SYSTEMS AND INTERACTION	7	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	A consistent and up-to-date introduction to basic facts and theories regarding human sensory perception. The teaching covers the physical and physiological aspects of each sensory modality and its perceptual characteristics. Emphasis is given on how perceptual experience relates to the physical properties of the external world, the characteristics of sensory signals, and the architectural principles of the nervous system.	56	119
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	9		AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	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
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80585	CHEMISTRY AND BIOCHEMISTRY	9		AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	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	9		AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	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
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80585	CHEMISTRY AND BIOCHEMISTRY	9		AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	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 COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM/07	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	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
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM/07	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	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
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80586	MOD. 1 CHEMISTRY AND ORGANIC CHEMISTRY	5	CHIM/07	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	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	5	CHIM/07	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	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 | 4 | BIO/10 | AFFINI O INTEGRATIVE | Attività Formative Affini 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 design/implementation 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 integration between the different human organs. | 32 | 68 |

| MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE | 1 | 80587 | MOD. 2 BIOCHEMISTRY | 4 | BIO/10 | AFFINI O INTEGRATIVE | Attività Formative Affini 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 design/implementation 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 integration between the different human organs. | 32 | 68 |

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	80587	MOD. 2 BIOCHEMISTRY	4	BIO/10	AFFINI O INTEGRATIVE	Attività Formative Affini 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 design/implementation 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 integration between the different human organs.	32	68

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	80587	MOD. 2 BIOCHEMISTRY	4	BIO/10	AFFINI O INTEGRATIVE	Attività Formative Affini 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 design/implementation 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 integration between the different human organs.	32	68
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	86744	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 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	48	102

									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	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 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.	48	102

NEUROENGINEERING AND NEUROTECHNOLOGIES	1	86744	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 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.	55	95
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	86744	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 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.	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.	36	39
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	104819	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.	36	39
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.	36	39
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	104819	ENGLISH LANGUAGE 2	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Inglese	Development of the learners' communicative competence in English at the B2 level of the CEFR, with particular regard to receptive language skills (reading and listening comprehension) and metalinguistic competence. Expansion of the vocabulary relating to the technical-scientific area with particular regard to	36	39

								the biomedical field, including robotics, artificial intelligence, automation, nanotechnologies and 3D printing.		
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Inglese	Internship in the laboratory, focused on learning specific techniques pertinent to the choice path and on carrying out an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106727	NEUROENGINEERING RESEARCH TRACK	2	ING-INF/06	ALTRE ATTIVITA'	Tirocini Formativi e di Orientamento	Inglese	Internship in the laboratory, focused on learning specific techniques pertinent to the choice path and on carrying out an individual project	40	10
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106729	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 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.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.	48	102

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106735	MATHEMATICAL METHODS FOR BIOENGINEERING	6	MAT/08	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms The module aims at introducing some of the main mathematical tools that are largely used in applications, and experimenting with them using the PC. Specific topics include: iterative algorithms and gradient methods, interpolation, regularization and inverse problems.	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106736	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	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	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	69	81
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106736	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	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Definition of neural interfaces and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advanced signal processing for neural interfaces. Encoding and decoding of information in neural interfaces. Definition of unidirectional and bidirectional neural interfaces. Brain-machine interfaces and invasive and noninvasive neural prostheses for the central nervous system: current materials, methods, and applications	78	122
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	106737	NEURAL AND BRAIN-COMPUTER INTERFACES	8	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	Definition of neural interfaces and state of the art in the field of neuro-electronic systems. Techniques for measuring the electrophysiological activity of excitable cells and tissues. Advanced signal processing for neural interfaces. Encoding and decoding of information in neural interfaces. Definition of unidirectional and bidirectional neural interfaces. Brain-machine interfaces and invasive and noninvasive neural prostheses for the central nervous system: current materials, methods, and applications	64	136
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	106739	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course aims to provide a critical analysis of the methods for analyzing the neuronal signal starting from the characterization of the single spike, to the activity of multiple cells up to the analysis of the electroencephalographic signal. The course will provide the basics to be able to manipulate, analyze and critically interpret the most common electrophysiological data	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	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 extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support advanced practitioners in the field.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106746	BIOINFORMATICS	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	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 extract new knowledge, the simulation of biological processes, and the creation of knowledge-based systems to support advanced practitioners in the field.	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTEMS	6	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	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 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.	55	95
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106747	BIOSENSORS AND MICROSYSTEMS	6	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	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 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.	55	95
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	2	ING-IND/34	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

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106748	ENGINEERING FOR PERSONALIZED MEDICINE RESEARCH TRACK	2	ING-IND/34	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
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	106753	TECHNOLOGIES FOR PERSONALIZED MEDICINE	9	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	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 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.	72	153

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	106753	TECHNOLOGIES FOR PERSONALIZED MEDICINE	9	ING-IND/34	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	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 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.	72	153
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Italiano (Inglese a richiesta)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Italiano (Inglese a richiesta)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39
NEUROENGINEERING AND NEUROTECHNOLOGIES	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Italiano (Inglese a richiesta)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	1	111660	ITALIAN LANGUAGE FOR FOREIGN STUDENTS	3		ALTRE ATTIVITA'	Ulteriori Conoscenze Linguistiche	Italiano (Inglese a richiesta)	The course aims to provide a basic knowledge of spoken and written Italian, and a glimpse at Italian culture and heritage.	36	39

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80575	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 neuronal networks. Particular emphasis will be given to the interplay between exhibited patterns of electrophysiological activity and the kind of used model.	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	80575	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	6	ICAR/01	A SCELTA	A Scelta dello Studente	Inglese	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	6	ICAR/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese	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

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL AND HEALTHCARE 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 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)	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80606	CLINICAL AND HEALTHCARE 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 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)	48	102

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	80606	CLINICAL AND HEALTHCARE 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 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)	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	80606	CLINICAL AND HEALTHCARE 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 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)	48	102

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	6	MED/42	A SCELTA	A Scelta dello Studente	Inglese	To provide essential knowledge relating to: the concept of health, protection and promotion of health, health education; identification and control of the causes of disease and risk factors in the environment; including the epidemiology and prevention of the main infectious and chronic-degenerative diseases.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	80620	APPLIED HYGIENE	6	MED/42	A SCELTA	A Scelta dello Studente	Inglese	To provide essential knowledge relating to: the concept of health, protection and promotion of health, health education; identification and control of the causes of disease and risk factors in the environment; including the epidemiology and prevention of the main infectious and chronic-degenerative diseases.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84341	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
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	84341	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).	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84341	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 COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84344	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	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	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	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
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84386	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
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84386	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

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84386	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 COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	84391	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 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	42	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	84391	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 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	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	84391	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 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	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	86775	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 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.	55	95
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	86775	REHABILITATION ENGINEERING AND PROSTHETIC DEVICES	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	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 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	55	95

									advanced techniques of functional assessment, prosthetics, sensory substitution, neurorehabilitation and assistive technologies.		
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	94827	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 clinic and to research in the healthy subject and in neurological patients	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	94827	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 clinic and to research in the healthy subject and in neurological patients	48	102

REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	94827	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 clinic and to research in the healthy subject and in neurological patients	48	90
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95614	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	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	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
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	98288	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	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
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	98288	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	106728	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	24	51
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106728	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	37	38
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106728	PROFESSIONAL SKILLS	3	ING-INF/06	ALTRE ATTIVITA'	Altre Conoscenze Utili per l'Inserimento Nel Mondo del Lavoro	Inglese	Professionalizing teaching, focused on ethics in professional and scientific practice, regulations on intellectual property rights and certification of medical devices, management of clinical trials	24	51

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106729	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 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.	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106730	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 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.	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106730	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 therapies. The applicative examples, that will be proposed, will thus have the purpose of stimulating and developing	48	102

									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	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- 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.	48	102

NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106731	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 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 electronic 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.	48	102
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106734	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	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese	The course will introduce the fundamental concepts and principles of machine learning and artificial intelligence as it applies to medicine	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106734	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	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	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course will provide a design guideline of neuromorphic models for the representation and distributed processing of multidimensional signals. The emphasis is on both computational primitives and architectural schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments are presented as case studies.	48	102
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	106738	NEUROMORPHIC COMPUTING	6	ING-INF/06	CARATTERIZZANTI	Ingegneria Biomedica	Inglese	The course will provide a design guideline of neuromorphic models for the representation and distributed processing of multidimensional signals. The emphasis is on both computational primitives and architectural schemes. Applications to the development of perceptual engines to enable autonomous behaviors in complex systems and natural environments are presented as case studies.	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106739	NEURAL SIGNAL ANALYSIS	6	ING-INF/06	A SCELTA	A Scelta dello Studente	Inglese	The course aims to provide a critical analysis of the methods for analyzing the neuronal signal starting from the characterization of the single spike, to the activity of multiple cells up to the analysis of the electroencephalographic signal. The course will provide the basics to be able to manipulate, analyze and critically interpret the most common electrophysiological data	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106740	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 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	48	102

								sensory disfunctions, and 4) lead/promote early diagnosis		
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106740	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 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	48	102
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	106744	BIOMATERIALS	6	ING-IND/22	AFFINI O INTEGRATIVE	Attività Formative Affini o 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 hydrogels and bone cements will be presented, adopting physico-chemical characterization methods like rheometry, calorimetry, surface enrgies, also focusing over the interactions within natural tissues.	48	102
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106744	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-chemical characterization	48	102

									methods like rheometry, calorimetry, surface enrgies, also focusing over the interactions within natural tissues.		
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	AFFINI O INTEGRATIVE	Attività Formative Affini o Integrative	Inglese		0	0
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106825	WEARABLE DEVICES AND INTERNET OF HEALTHCARE THINGS	6	INF/01	A SCELTA	A Scelta dello Studente	Inglese		0	0
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106758	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 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.	24	51
REHABILITATION ENGINEERING AND INTERACTION TECHNOLOGIES	2	106758	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 tolerance and replication, service oriented architectures platforms, embedded operating systems, real time and streaming data, geolocation, and collaborative framework.	24	51

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	106824	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	3	INF/01	A SCELTA	A Scelta dello Studente	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
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	108682	MECHANICS OF BIOLOGICAL TISSUE	6		A SCELTA	A Scelta dello Studente	Inglese		0	0
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108682	MECHANICS OF BIOLOGICAL TISSUE	6		A SCELTA	A Scelta dello Studente	Inglese		0	0
MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	A SCELTA	A Scelta dello Studente	Inglese	The unit will provide the basic notions of mechanics of biological tissue and teach them how to formulate appropriate mathematical models. It will also provide notions on numerical analysis to find numerical solutions of the mathematical problems. One of the aims of the course is to teach the students how to work independently on a new project and how to find and study the existing scientific literature	24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	95279	MOD. 1 CONTINUUM MODELS FOR BIOLOGICAL TISSUE	3	ICAR/01	A SCELTA	A Scelta dello Studente	Inglese	The unit will provide the basic notions of mechanics of biological tissue and teach them how to formulate appropriate mathematical models. It will also provide notions on numerical analysis to find numerical solutions of the mathematical problems. One of the aims of the course is to teach the students how to work independently on a new project and how to find and study the existing scientific literature	24	51

MATERIALS AND DEVICES FOR PERSONALIZED MEDICINE	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING-IND/06	A SCELTA	A Scelta dello Studente	Inglese	The unit will first introduce senses and sensory systems in living organisms with special focus on the biomechanics of one sensory system. We will build a mathematical model to study how organisms collect and process specfici sensory information from their surroundings. A main aim of the module is to develop the skills necessary for group work, learn how to critically read the literature, develop simple mathematical models that capture the fundamental ingredients of an open problem and assess its potential, limitations and potential improvements	24	51
NEUROENGINEERING AND NEUROTECHNOLOGIES	2	108681	MOD. 2 MECHANICS OF SENSORY SYSTEMS	3	ING-IND/06	A SCELTA	A Scelta dello Studente	Inglese	The unit will first introduce senses and sensory systems in living organisms with special focus on the biomechanics of one sensory system. We will build a mathematical model to study how organisms collect and process specfici sensory information from their surroundings. A main aim of the module is to develop the skills necessary for group work, learn how to critically read the literature, develop simple mathematical models that capture the fundamental ingredients of an open problem and assess its potential, limitations and potential improvements	24	51
INFORMATION AND COMMUNICATION TECHNOLOGIES FOR PERSONALIZED MEDICINE	2	111103	ARTIFICIAL INTELLIGENCE	6	ING-INF/05	A SCELTA	A Scelta dello Studente	Inglese	The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the "deductive" side of the discipline. Students will learn basics in propositional and first order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action effects will be added on top of the basic capabilities for representation and reasoning.	48	102

| NEUROENGINEERING AND NEUROTECHNOLOGIES | 2 | 111103 | ARTIFICIAL INTELLIGENCE | 6 | ING-INF/05 | A SCELTA | A Scelta dello Studente | Inglese | The goal of the course is to introduce students to topics in Artificial Intelligence, mostly on the "deductive" side of the discipline. Students will learn basics in propositional and first order logic and apply them in the context of knowledge representation and reasoning. Also the basic principles of heuristic search and planning in the context of full observability and deterministic action effects will be added on top of the basic capabilities for representation and reasoning. | 48 | 102 |