

Biomedical Engineering Education in Italy

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or at the mirror site <http://biomant.die.unina.it/aiimb/bme.htm>)

1. Introduction

Biomedical engineering teaching activities in Italy started in the years 1968-69. The course of "Biomedical Electronics" was activated at the University of Padova and at the University of Naples and the courses of "Bio-energetic" and "Biological Electronics" started at the Polytechnic of Milan. Since then many other courses and educational programmes have started in many Italian University. Post-graduate courses started in the years 1971-72 when "Post-graduated courses of Biomedical instrumentation" was set-up at the University of Naples, while Bioengineering PhD courses were activated in 1982 as consortium of various Universities with two administrative headquarters in Milan and Bologna.

In 2000, about 150 undergraduate courses in Biomedical Engineering were active at 19 Italian Universities (Ancona, Bologna, Brescia, Firenze, Genova, Milano, Modena e Reggio Emilia, Napoli, Padova, Pavia, Pisa, Roma 1 "la Sapienza", Roma 2 "Tor Vergata", Roma 3, Roma Campus Biomedico, Sassari, Siena, Torino and Trieste), while PhD Courses in Bioengineering and Post-graduate courses were available in 9 Universities (see Appendix 1).

Accordingly to the reform of the European Higher Education, since 2001, a new educational path was adopted in Italy, consisting of a first level degree (3 years) eventually followed by a second level, specialist degree (2 years) and /or Masters and finally by the PhD.

At moment, the Universities of Ancona, Bologna, Genova, Milano, Napoli, Padova , Pavia, Pisa, Roma 1 "la Sapienza", Roma Campus Biomedico, Torino and Trieste offer the first level degree (3 years) in Biomedical Engineering and in the next future will offer the specialist degree (2 years). Other Universities offer specific curricula or some modules of Biomedical Engineering within other engineering degree courses (see Appendix 2).

2. The National Society

As early as 1965, a group of medical engineers headed by Prof. G. Francini met to formally organise the Italian Electronic Group applied to Medicine and Biology in affiliation to the International Federation of Medical and Biological Engineering (I.F.M.B.E.).

Later, in 1967, the constitution of the Association was approved with the name "Associazione Italiana di Ingegneria Medica e Biologica" (A.I.I.M.B.). It had started with 76 members of medical engineers, physicist and physicians all over Italy. Its objective are scientific informative and educational with the specific aims of encouraging researches, spreading scientific information, applying knowledge and promoting collaboration with other specific groups.

At present the A.I.I.M.B. counts about 130 active Members. Most of them work at Universities while the others are clinical engineers and physicians working at hospitals and other healthcare departments.

The A.I.I.M.B. had participated and organised many scientific activities, conferences, symposia, round tables on different topics regarding Biomedical Engineering.

In 1997, A.I.I.M.B. initiated the series of the MEDICON - Mediterranean Conferences on Medical and Biological Engineering (September, 12-17, 1977 - Sorrento, Italy). After, A.I.I.M.B. hosted also the VI MEDICON in Capri island (July, 5-10, 1992 - Italy) and will host also the X MEDICON in Ischia island (June or September 2004 - Italy).

The A.I.I.M.B. coordinates also in cooperation with other Italian and International Technical and Scientific Organizations general and specialized activities in the field of Biomedical Engineering and Clinical Engineering within the structures of the National Health Services. A.I.I.M.B. participates in the Italian Group Sub-Committee 62D of the International Electrotechnical Commission for the standardization of medical equipments.

The A.I.I.M.B. has two Working Groups formed since 1983 on "Clinical Engineering" and on "Biomechanics". Recently has been formed a Working Group on "Cellular Engineering".

The A.I.I.M.B. has cooperation with different Italian associations (such as: Gruppo Italiano di Ultrasonologia Vascolare - GIUV, Società Italiana Reti Neuroniche, Associazione Italiana di Fisica Biomedica - AIFB, Sezione Italiana dell'International Society of Electrophysiological Kinesiology - ISEK).

3. BME Education, Training and Accreditation in Italy

3.1 Education

University degree programmes in Biomedical Engineering at both under-graduate and post-graduate level are provided in Italy.

Accordingly with the new definitions of the Italian Ministry of Education, Universities and Research, there are two Scientific-Disciplinary Sectors (i.e. homogeneous scientific-educational topics or areas) concerning Biomedical Engineering education at University level:

"Electronics and Informatics Bioengineering" ING-INF/06:

This sector born from the organic integration of the methodologies and the technologies proper of the engineering, principally of the information, with the medical and biological problems of the life science, of the clinical engineering, of the labour world and of the sport. The basic methodologies of this sector concern the modelling of the physiological systems (from the cellular components to the apparatus and organs); the description of the electrical and/or magnetical phenomena and the device to measure or modify them; data and signal processing; biomedical images; the representation of the medical and biological knowledge. The technologies include the biomedical and biotechnological instrumentation (diagnostic, therapeutic, and rehabilitative: from its elementary components to the integrated hospital systems); prosthesis; biomedical robots; artificial intelligence systems; systems for the healthcare management and organisation; informatics systems at patient, ward, hospital, regional and national level; medical informatics; telemedicine. Advanced research areas in biology and neuroscience include cellular and tissue engineering; informatics techniques for biology and neurology (neuro-informatics and bio-informatics); bio-electronics.

"Industrial Bioengineering" ING-IND/34:

This sector born from the organic integration of the methodologies and the technologies proper of the industrial engineering, principally of the mechanics and chemistry, with the medical and biological problems of the life science. The aim of such integration is directed to the technological, industrial, scientific, clinic and hospital

environment. Scientific-disciplinary contents relate to the bioengineering application of methodological, technological, theoretical, and experimental aspects proper of the chemical and mechanical engineering and therefore the study, the planning, the technologies, and the functional evaluation of medical instrumentation, device or implants, of natural and artificial materials, tissues, apparatus and organism by means of models, analytical and numerical instruments. Methods proper of the sector are based on structure-property link characteristic of biomaterials and biomechanical structures. Also the knowledge thorough examination, based on the observation scale, allows the biomechanical characterisation of the biological structures and the analysis of the biological-artificial interface characteristics, which are the support for the planning of biomedical devices.

At present, there are a total of 83 teachers (of which 27 full professors, 28 associate professors and 28 researchers) belonging to ING-INF/06 sector and there are a total of 24 persons (of which 9 full professors, 11 associate professors and 4 researchers) belonging to ING-IND/34 sector.

3.1.1 Undergraduate degrees

In 2000, about 150 undergraduate courses in Biomedical Engineering were active at 19 Italian Universities (Ancona, Bologna, Brescia, Firenze, Genova, Milano, Modena e Reggio Emilia, Napoli, Padova, Pavia, Pisa, Roma 1 "la Sapienza", Roma 2 "Tor Vergata", Roma 3, Roma Campus Biomedico, Sassari, Siena, Torino and Trieste), while PhD Courses in Bioengineering and Post-graduate courses were available in 9 Universities (see Appendix 1 for details).

The 2000-2001 academic year witnesses a historic transition because Italy will pass from the traditional system of one level (the degree) to a system organised around different levels (the degree, the specialised degree, the master's degree, and the doctorate of research), aligned with the goal of a European space of higher education which is contained in the declaration signed by the Ministers of Education or their equivalents of twenty-nine European countries at the University of Bologna on 19 June 1999. The challenge which universities are now facing is a colossal one, and it has forced them to revise all the university curricula and to create new ones adapted to a society based upon knowledge which innovates and renews at extraordinary rhythms. In this revision the universities are finally enjoying certain spaces of autonomy and in the interest of the students are interacting with employers' associations and trade unions and other state and private systems which are interested in university education and training.

The credits system have been adopted to be in line with the ETCS European system of credits, in which credits go from 1 to 60, are based upon the course unit, and describe the total work burden which each course unit requires.

At moment, the Universities of Ancona, Bologna, Genova, Milano, Napoli, Padova, Pavia, Pisa, Roma 1 "la Sapienza", Roma Campus Biomedico and Torino offer the first level degree (3 years) in Biomedical Engineering and in the next future will offer the specialist degree (2 years). Other Universities offer specific curricula or some modules of Biomedical Engineering within other engineering degree courses (see Appendix 2 for details).

3.1.2 Postgraduate degrees

In Italy the PhD in Bioengineering is a research degree, usually of 3 years duration. Entry to Doctoral study is allowed to postgraduates (until now, students who took a 5 years university degree), where having a Master's degree or a post-graduate specialisation is not a prerequisite.

On 1982 it started a PhD course in "Bioengineering", based on a consortium of the University of Genova, Milano, Padova, Pavia and Pisa (with administrative headquarters in Milan) and another Bioengineering PhD course based on a consortium of the University of Ancona, Bologna, Firenze, Napoli and Roma (with administrative headquarters in Bologna).

On 1985 a Bioengineering curriculum was activated within the PhD in Information Engineering at the University of Trieste.

On 1997 a PhD course in "Bioengineering and Medical Informatics" started at the University of Pavia.

On 1998 a PhD course in "Bioengineering and Bioelectronics" started at the University of Genova.

On 2000, at the University of Pavia, the PhD course in "Bioengineering and Medical Informatics" turns into the PhD course in "Bioengineering and Bioinformatics".

On 2000 a PhD course in "Biomedical Technologies Applied to Dentistry" started with a collaboration of the University "Federico II" of Napoli and the Second University (SUN) of Napoli.

On 2001 a PhD course in "Bioengineering" started at the University of Padova.

On 2001 a PhD course in "Biomedical Engineering" started at the Polytechnic of Torino.

On 2001 a PhD course in "Healthcare Economics and Management" started at the University "Federico II" of Napoli (a collaboration of the Faculties of Medicine, Economy and Engineering).

On 2001 a PhD course in "Diagnostic of Laboratory and Bioengineering" started with a collaboration of the University "Federico II" of Napoli and the Second University (SUN) of Napoli.

In 1989 the Italian Universities of Bologna, Milano, Napoli and Padova join the "European Course on Biomedical Engineering and Medical Physics" organised in Patras, Greece, within the Erasmus project. The Italian participation to the Course, continuing so far, consists of both teachers and students.

In 1991 a postgraduate specialisation school in Clinical Engineering was established at the University of Trieste. The duration is two years.

3.1.3 Other educational activities

Since 1982, the Italian scientific community of Bioengineering annually organises monothematic schools held in Bressanone of a duration of few days about specific Biomedical Engineering topics. Every year many students (undergraduate and postgraduate) and teachers participate to the school.

1982 - Methods and analysis of the neuro-sensorial systems; 1983 - The computer in the clinical practice; 1984 - Biomaterials; 1985 - Eidetic Bioengineering; 1986 - Bioengineering of the cardiovascular system; 1987 - Bioengineering of the Rehabilitation; 1988 - Structure of the biomedical knowledge; 1989 - Cellular and molecular bioengineering; 1990 - Bioengineering of the artificial organs; 1991 - Neuroscience and science of the artificial: from neuron to intelligence; 1992 - Bioelectronics and nanotechnologies for bioengineering; 1993 - Biosystems and complexity; 1994 - Biomedical and healthcare technologies: development evaluation and management; 1995 - Prosthesis and aids for the communication; 1996 - Informatics healthcare systems; 1997 - Mechanics of the biological tissues; 1998 - Bioengineering of the metabolic systems; 1999 - Technology and methodology for functional images. 2000 - Analysis and modification of biomolecules and cellules; 2001 - Bioengineering of the respiratory system.

Various courses on specific Biomedical Engineering subject have been organised for PhD students in different Italian Universities.

3.2 Training

At present, biomedical engineers in Italy usually do not undergo additional training to their education.

On the contrary of Medical Physicists, in Italy there is not yet any recognition of the Clinical Engineer by the National Health Service. Eventual training for engineers employed in hospital, healthcare structures or industries is optional and, in general, carried out independently.

3.1 Accreditation of Education and Training

3.3.1 Accreditation of Degrees

At present, in Italy there is not yet an accreditation process for the University education nether for specific training.

After the ministerial decree (DM 509/99) on autonomy in the sphere of teaching, some of the traditional customs and habits of Italian universities are changing, passing from the traditional system of one level (the degree) to a system organised around different levels (the degree, the specialised degree, the master's degree, and the doctorate of research), aligned with the goal of a European space of higher education which is contained in the "Bologna Declaration".

Recent documents already contain the new general organisational principles and present the characteristics that the university system should have acquired at the end of the process of innovation, among which there is the accrediting of the courses of study (a system of certification based on the cultural value of a qualification derived from university studies, on the meeting of the social and economic demand, and on the suitability of the resources deployed by universities).

In particular, on July 2001, the National Committee for the Evaluation of the University System (Italian Ministry for Education Universities and Research), issued a document (Doc 12/01) about the "Activation of an accrediting system of the degree courses in the Italian Universities: first recommendation and proposals"

Furthermore, the Institution "National System for the Accreditation of the Courses of Study in Engineering" (S.I.N.A.I.) will be soon constituted. The aim of the SINAI Institution is to determine the Minimal Requirements (in terms of Credits and arguments covered) in order that a Courses of Study would be "accredited" (i.e. to get recognition at national and eventually international level). At moment the Accreditation matter is to the attention of the CRUI (The Italian Rectors' Conference) and of the National Committee for the Evaluation of the University System.

Concerning the Biomedical Engineering Education, on April 2001 the Education Committee of the National Group of Bioengineering submitted to the Committee of the Deans a proposal about the arguments of the courses of Biomedical engineering (see Table 1). On July 2001, the Committee of the Deans transmitted a new proposal (see Table 2) to receive comments, remarks and objections in order to prepare soon a document about the Minimal Requirements for the Courses of Study in Engineering.

Table 1

<p>Bioengineering Models of biological systems. Transfer function. Feedback. Stability. Simulation. Identification.</p> <p>Biomaterials Metallic, ceramic, polymeric, materials and their chemical-physical properties. Biocompatibility and biodegradation.</p> <p>Biomechanics Mechanical properties of biological and artificial materials. Human motion analysis. Prosthesis.</p> <p>Biology and Physiology Cellular biology. Tissues biology. Integrated physiological functions (respiration, circulation metabolism, functions of the neuro-sensorial and muscular system, water and metabolite homeostasis).</p> <p>Biomedical signal and image processing Principal characteristics of the biomedical signals and images. analysis in the frequency domain. Sampling. Numerical filtering.</p>
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Applied Electronics

Components. Analog and digital electronic circuits. Semiconductor memories. Analog to digital conversion.

Electrotechnique

Electrical circuit in DC and AC. Transient response. Elements of electrical devices.

Mechanics and Thermodynamics

Mechanics of the rigid body, elastic bodies and fluids. Mechanical components. Kinematics chains.

Thermodynamics of the open system. Energy and mass balance. Transport phenomena.

Biomedical instrumentation

Elements of the measure. Functioning principles of the main instruments for diagnosis therapy and rehabilitation. Network instruments and telemedicine. Electrical safety of the biomedical device and legal aspects.

Table 2**Mechanics and Biomechanics**

Mechanics of the rigid body, elastic bodies and fluids. Mechanical components. Kinematics chains. Biomedical applications. Operating devices: pumps and compressors. Mechanical properties of biological and artificial materials. Prosthesis.

Bioengineering

Mathematical models of simple biological systems. Experimental assessments and determination of empirical parameters. Simulations.

Biomaterials

Metallic, ceramic, polymeric, materials and their chemical-physical properties. Biocompatibility and biodegradation.

Biomedical signal and image processing

Principal characteristics of the biomedical signals and images. Analysis in the frequency domain. Sampling. Numerical filtering.

Measures and biomedical instrumentation

Measure theory. Measure of electrical, thermal and mechanical quantities. Functioning principles of the main instruments for diagnosis therapy and rehabilitation. Safety of the biomedical devices.

Biology and physiology

Cellular biology. Tissues biology. Integrated physiological functions (respiration, circulation metabolism, functions of the neuro-sensorial and muscular system, water and metabolite homeostasis).

Technological installations in hospitals

Conditioning and heating systems. Electrical systems. Auxiliary installations and normative aspects. Thermodynamics and transport phenomena. Thermodynamics of open systems. Mechanics of the fluids. Mass and heat transport.

Electrotechnique

Electrical circuit in DC and AC. Transient response. Principles of functioning of electrical devices. Building typologies. Converters and inverters.

Applied electronics

Components. Electrical analogical circuits, elementary amplifier and the operational amplifier. Digital circuits and main logic families. Semiconductor memories. Analog to digital conversion.

Automatic controls.

Analysis of the control systems. Criteria for stability. Methods of synthesis of control systems. Basic aspect of the digital control. Components of a control system, sensors and actuators.

3.3.2 The Right to practice for engineers

In Italy engineers who intend practice the engineering profession have to register with the Italian Council of the Engineers (Ordine degli Ingegneri).

Recently, after the new reform of university education, the Council of the Engineers decided to form two sections. Section A for those having the Specialised Degree in Engineering (giving the professional title of Engineer) and Section B for those having only the Degree in Engineering (giving the professional title of Junior Engineer).

The Italian Council of the Engineers has been also divided in three sectors: Civil an Environment; Industrial; Information. The graduates in Biomedical Engineering (Degree o Specialist Degree) have the possibility to choose between the Industrial and Information sectors.

List of Biomedical Engineering courses in ITALY on 2000

(this list is available at AIIMB web-site at the address :
http://biomant.die.unina.it/aiimb/bme_2000.htm)
updated to January 16, 2001

Note that Italian names of the courses, topics and degrees have been freely translated to English

University of ANCONA

Degrees:

Electronics Engineering Degree (Biomedical course)

PhD in Bioengineering

Courses:

- Bioengineering
- Bioengineering of the physiological systems
- Biological systems models

University of BOLOGNA

Degrees:

Biomedical Engineering Degree

Electronics Engineering Degree (Biomedical course)

Biomedical Engineering Bachelor

PhD in Bioengineering (consortium with the Univ. of Ancona, Firenze, Napoli and Roma 1)

Courses:

- Physiology
- Automation and organization of the health services
- Bioengineering I
- Bioengineering II
- Bioengineering III
- Biomedical data and signals processing
- Biomedical instrumentation
- Biomaterials
- Biomechanics constructions

University of BRESCIA

Degrees:

Electronics, Mechanics, Civil, Management Engineering Degree

Courses:

- Automation and organization of the health services

University of FIRENZE

Degrees:

Electronics Engineering Degree (Bioengineering course)

Mechanics Engineering Degree (Biomedical course)

PhD in Bioengineering

Courses:

- Physiology
- Biological systems models

- Biomedical instrumentation
- Biomedical technologies
- Medical informatics
- Biomechanics
- Biomechanics constructions

University of GENOVA

Degrees:

Biomedical Engineering Degree

PhD in Bioengineering

Courses:

- Bioelectromagnetism I
- Bioelectromagnetism II
- Biomechanics I
- Biomechanics II
- Bioimages
- Biomaterials
- Bioelectrochemistry
- Bioengineering and medical informatics
- Biomedical data and signals processing
- Medical informatics II
- Bioengineering laboratory
- Biological systems models
- Perceptive systems models
- Anthropomorphological robotics
- Natural and artificial intelligent systems
- Biomedical instrumentation
- Biomedical technologies
- Biochemistry
- Human physiology

Polytechnic of MILANO

Degrees:

Biomedical Engineering Degree

Bioengineering Bachelor

PhD in Bioengineering

Courses:

- Human physiology
- Biomaterials I
- Biomechanics
- Bioelectromagnetism
- Instrumental analysis and materials control (Lab)
- Automation and organization of the health services
- Bioimages
- Bioengineering of the physiological systems I
- Bioengineering of the physiological systems II
- Bioengineering of the rehabilitation and prosthesis I

- Bioengineering of the rehabilitation and prosthesis II
- Molecular biology
- Biomachines
- Biomaterials II
- Biomaterials III
- Biomechanics of the rehabilitation I
- Biomechanics of the rehabilitation II
- Biomechanics of the rehabilitation III
- Biomechanics constructions (Lab)
- Biomedical data and signals processing I
- Biomedical data and signals processing II
- Biomedical data and signals processing III (Lab)
- Biological transport phenomena
- Medical informatics I
- Medical informatics II
- Medical informatics III (Lab)
- Artificial organs and prosthesis I
- Artificial organs and prosthesis II
- Natural and artificial intelligent systems
- Biomedical instrumentation
- Technology of the biomaterials
- Biomedical technologies

University of MODENA and REGGIO EMILIA

Degrees:

Medicine, Health-care planning sciences Degree

Courses:

- Biomedical technologies
- Medical informatics

University of NAPOLI "Federico II"

Degrees:

Electronics Engineering Degree (Biomedical course)

PhD in Bioengineering

PhD in Biomedical Technologies Applied to Dentistry

Courses:

- Biomedical electronics
- Biomedical data and signals processing
- Biomedical instrumentation
- Biomedical technologies
- Automation and organization of the health services

University of PADOVA

Degrees:

Electronics Engineering Degree (Biomedical course)

Biomedical Engineering Bachelor

Courses:

- Bioengineering
- Biological systems models
- Biomedical data and signals processing
- Biomedical instrumentation
- Biomedical technologies
- Elements of physiology
- Medical informatics
- Biomachines
- Biomaterials
- Biomechanics
- Biomechanics construction

University of PAVIA*Degrees:*

Biomedical Engineering Degree

Computer science Degree (Bioengineering course)

PhD in Bioengineering and Bioinformatics

Courses:

- Human physiology
- Biomedical data and signals processing
- Bioengineering
- Automation and organisation of the health services
- Economics of health services
- Biomedical technologies
- Biomedical instrumentation
- Medical informatics

University of PISA*Degrees:*

Electronics Engineering Degree (Biomedical course)

Bioengineering Bachelor

Courses:

- Bioengineering I
- Bioengineering II
- Biomedical electronics I
- Biomedical electronics II
- Biomedical data and signals processing I
- Biomedical data and signals processing II
- Automation and organization of the health services

University of ROMA 1 "La Sapienza"*Degrees:*

Electronics, Telecommunications, Computer science, Mechanics Engineering Degree
(Bioengineering course)

Movement sciences Degree

PhD in Bioengineering

Courses:

- Biological systems models
- Biomedical instrumentation
- Seminars and laboratory of human physiology
- Biomedical data and signals processing
- Hospital systems
- Bioelectromagnetic interaction
- Biomechanics of the human movement

University of ROMA 2 "Tor Vergata"*Degrees:*

Medical Engineering Degree

Courses:

- Science and technology of the materials of biological interest
- Mechanics of biological systems
- Human biomorphology
- Diagnosis devices
- Physiology

University of ROMA 3*Degrees:*

Electronics Engineering Degree

Mechanics Engineering Degree (Bioengineering course)

Courses:

- Biomedical instrumentation

ROMA Campus Biomedico*Degrees:*

Biomedical Engineering Degree

Courses:

- Biomaterials
- Elements of physiology and anatomy
- Hospital systems
- Biomedical instrumentation
- Biochemistry
- Bioelectrochemistry and biomedical technologies
- Biomaterials II
- Biomechanics
- Chemical kinetics and biochemistry
- Biomedical data and signals processing
- Biomedical transport phenomena
- Physiology
- Biomedical fluid-dynamics
- Medical informatics
- Bioelectromagnetic interaction

- Nuclear methods for therapy and diagnostic
- Biological systems models
- Artificial organs

University of SASSARI

Degrees:

Medicine and Dentistry Degree

Courses:

- Mathematics and physics methodologies

University of SIENA

Degrees:

Medicine and Surgery Degree

Bachelor (audiometrist technician, audioprosthesis technician, physical therapist, dental hygienist, nurse, logopaedist, technician in neurophysiopathology, orthotist-assistant in ophthalmology, obstetrician, sanitary technician of medical radiology, sanitary technician of biomedical laboratory)

Courses:

- Medical physics and bioengineering
- Human physiology (physiological systems models)
- Medical informatics
- Biomedical technologies
- Biomedical instrumentation
- Biomedical electronics
- Biomedical data and signals processing
- Electronic bioengineering

Polytechnic of TORINO

Degrees:

Mechanics Engineering Degree (Biomedical course)

Electronics Engineering Degree (Bioengineering course)

Courses:

- Biomechanics
- Biomechanics constructions
- Biomaterials
- Basic techniques of biomedical data and signals processing
- Advanced techniques of biomedical signals processing
- Human physiology and measurements on living systems
- Biomedical instrumentation

University of TRIESTE

Degrees:

Electronics Engineering Degree (Biomedical course)

School of specialization in Clinic Engineering

Bachelor (sanitary technician of medical radiology)

Courses:

- Data and images of clinical interest processing
- Elements of human physiology

- Elements of human morphology
- Hospital information systems
- Instrumentation for functional explorations
- Telematics and integration of the health services
- Biomaterials, artificial organs and prosthesis
- Electrical systems in the hospitals
- Organization and management of the health services
- Planning and organization of the health services
- Health risks and prevention in hospital
- Safety and prevention in hospital environment
- Medical statistic and epidemiology
- Instrumentation for bioimages
- Instrumentation for clinical chemistry
- Bioengineering
- Biomedical instrumentation
- Radiology equipments-Electronic bioengineering
- Informatics and archiving-General informatics
- Informatics and archiving-Electronic bioengineering

Synoptic table of Biomedical Engineering degree courses in ITALY from the Academic year 2000-2001

This information is preliminary and in progress - last update September 2002

UNIVERSITY	BME topics in other degree	BME degree 3 years (class)	BME specialised degree +2 years	BME masters	BME PhD
University of ANCONA		Yes (Ind.)		Clinical Engineering*	
University of BOLOGNA	Electronics	Yes (Inf.)	Yes		Bioengineering
University of BRESCIA	Electronics, Mechanics, Civil, Management				
University of FIRENZE	Electronics, Mechanics				Bioengineering
University of GENOVA		Yes (Ind.,Inf.)	Yes		Bioengineering Bioelectronics
Polytechnic of MILANO		Yes (Ind, Inf.)	Yes		Bioengineering
University of MODENA e REGGIO EMILIA	Medicine, Health-care planning				
University of NAPOLI (Federico II)		Yes (Inf.)	Yes		Bioengineering, Healthcare economy, Bioengineering technologies in dentistry, Laboratory diagnostic and BME
University of PADOVA		Yes (Inf.)	Yes		Bioengineering
University of PAVIA		Yes (Inf.)	Yes		Bioengineering Bioinformatics
University of PISA		Yes (Ind.)	Yes		Robotics, Industrial automation systems, Bioengineering
University of ROMA 1 (La Sapienza)	Electronics, Informatics, Mechanics	Yes (Ind.,Inf.)	Yes		Bioengineering
University of ROMA 2 (Tor Vergata)	Medical Engineering				
University of ROMA 3	Electronics, Mechanics				
ROMA Campus Biomedico	Biomedical Engineering	Yes (Ind.)	Yes		
University of SASSARI	Medicine and Dentistry				
University of SIENA	Medicine and Surgery				
Polytechnic of TORINO		Yes (Ind.)	Yes		Biomedical Engineering
University of TRIESTE	Electronics	Yes (Inf.)	Yes	Clinical Engineering	Bioengineering

The classes of the BME, 3 years, degree can be: Information (Inf.) and Industrial (Ind.)

** preliminary information*

List of the Biomedical Engineering courses in ITALY
(within the BME 1st level Degree - 3 years)
from the Academic year 2000-2001

This information is preliminary and in progress - last update September 2002

Note that Italian names of the courses, topics and degrees have been freely translated to English

University of ANCONA

(started on the academic year 2002/2003)

BME Courses	CFU	Year
Bioengineering 1	6	I
Healthcare Economy and management	3	I
Physiology	6	I
Bioelectromagnetic interactions	6	I
Biomaterials	6	II
Bioengineering 2	9	III
Biomechanics of motion	9	III
Electromagnetic compatibility in hospitals	3	III
Biomedical instrumentation	6	III

University of BOLOGNA

(started on the academic year 2001/2002)

BME Courses	CFU	Year
Human physiology A	6	II
Human physiology B	6	II
Biomechanics	6	II
Bioengineering	6	II
Biomedical Laboratory L-A	3	II
Biomedical Instrumentation L	6	III
Biomaterials L	6	III
Clinical Engineering L	6	III
Biomedical Laboratory L-B or English course L-B	3	III

University of GENOVA

(started on the academic year 2000/2001)

BME Courses	CFU	Year
Bioengineering + Medical informatics	12	I / I S
Bioengineering Laboratory	5	II

Principles of Bioelectronics and Bioinformatics	10	II / I S
Principles of Biomedical Instrumentation	5	II / II S
Economics and Business Organisation or Economics and Health Systems Management		
Biological Systems Control and Models	5	III / II S
Biomedical Signals and Images Processing	5	III / I S
Mathematical Physics or Principles of Mechanics and Biomechanics	5	III / I S
Human Physiology	10	III
Medical Informatics II	5	III / I S
Informative Systems and Telemedicine	5	III / II S

Polytechnic of MILANO

(started on the academic year 2000/2001)

BME Courses	CFU	Year
Biology and Physiology I	10	I
Principles of Bioengineering Electronics	10	II / I S
Principles of Bioengineering Mechanics	7.5	II / I S
Principles of Bioengineering Chemistry	5	II / I S
Medical Informatics	5	II / II S
Bioelectricity e Biomagnetism I	5	III / II S
Biomechanics I	5	III / II S
Chemical Phenomena in Biological Systems I	5	III / II S
Safety and Regulations for Medical Equipment	2.5	
Clinical Instrumentation	5	III
Technology for Sensors and Instrumentation	5	III / I S
Instrumentations and Methods for Functional Evaluation	5	III / I S
Biomachines	5	III
Technology for Prosthesis and Artificial Organs	5	III / I S
Systems for Motor and Postural Rehabilitation	5	III / I S
Automation and Organization of the Health Systems	5	III
Clinical Biomes	2.5	III
Hospital Systems	5	III

University "Federico II" of NAPOLI

(started on the academic year 2002/2003)

BME Courses	CFU	Year
Principles of Bioengineering I	3	I / I S
Principles of Bioengineering II	3	II / II S
Biomedical Instrumentation	6	II / II S
Biomaterials I	3	II
Biomaterials II	3	III
Biomedical Data and Signals Processing	6	III / I S
Organization and Automation of the Health Services	6	III
Biomedical Technologies	6	III

Clinical Engineering	3	III
Artificial Organs and Prosthesis	3	III
Rehabilitation Technologies	3	III
Bioelectromagnetism	6	III
Installations in Hospitals	3	III
Systems in Hospitals	3	III
Cellular and Molecular Engineering	6	III

University of PADOVA

(started on the academic year 2001/2002)

BME Courses	CFU	Year
Biomaterials	6	II / III T
Biomechanics	6	III / I T
Biology and Physiology	6	III
Biomedical Signals and Models	6	III / II T
Biomedical Instrumentation	6	III / II T
Mechanics Bioengineering	6	III / III T
Biomedical Technologies	6	III

University of PAVIA

(started on the academic year 2000/2001)

BME Courses	CFU	Year
Bioengineering	5	I / II S
Chemistry and biomaterials	5	II / I S
Biology and human physiology	6	II / I S
Health information systems	5	II / II S
Biomedical data processing	5	II / II S
Biomechanics	6	II / II S
Medical informatics	5	II / II S
Biomedical signal processing	5	III / I S
Internet and medicine	5	III / I S
Biomedical technologies	5	III / I S
Biomedical instrumentation	5	III / I S
Clinical Engineering	5	III / II S

University of PISA

(started on the academic year 2001/2002)

BME Courses	CFU	Year
Biochemistry	6	I
Physiology	6	II
Biomedical Data and Signals Processing	12	II

Bioengineering Laboratory	3	III
Electronics Bioengineering	12	III
Biomedical Measurements and Biomedical Instrumentation	12	III
Organization and Automation of the Health Services	6	III
Medical Informatics	6	III
Chemistry and Chemistry Bioengineering	12	III
Mechanics Bioengineering	12	III
Biological transport phenomena	6	III
Biomaterials	6	III

University "La Sapienza" of ROMA

(started on the academic year 2001/2002)

BME Courses	CFU	Year
Seminars and laboratories of human anatomy and physiology	6	I
Biomedical Instrumentation	6	II
Hospital Systems	6+4 training	III
Biomedical Data and Signals Processing	5	III
Biological Systems Models	5	III
Biomedical Instrumentation II	10	III

University "Campus Bio-Medico" of ROMA

(started on the academic year 1999/2000)

BME Courses	CFU	Year
Anthropology and Epistemology	2	I
Biomaterials	5	II
Elements of Anatomy and Physiology	10	II
Health Information Systems	5	II
Biomedical Engineering Laboratory	3	II
General Ethics	2	II
Hospital Installations	10	III
Clinical diagnostics Measurements	5	III
Biomedical Instrumentation	8	III
Applied Ethics	2	III
Biomedical Engineering Laboratory	5	III
Digital Processing of Biomedical Signals	5	III

Polytechnic of TORINO

(started on the academic year 2000/2001)

BME Courses	CFU	Year
Physiology and elements of anatomy	5	I
Mechanics Bioengineering I	4	II / II S
Electronics Bioengineering I	4	II / II S
Technologies of the Biomaterials	6	II / II S
Mechanics of the Fluids for Bioengineering	4	III / I S
Mechanics Construction of Biomedical Devices	4	III / I S
Chemistry Bioengineering	5	III / I S
Electronics Bioengineering II	5	III / I S
Mechanics Bioengineering II	5	III / II S
Bioimages	5	III / II S
Management of health technologies	5	III / I S
Classification and interpretation of biomedical data	5	III / II S
Cellular mechanics and tissues engineering	5	III / II S
Support to clinical decision	5	III / II S
Mechanical manufacturing of biomedical devices	4	III
Assisted design of biomechanical structures	5	III
Medical informatics	5	III / I S
Hospital systems	5	III / I S

University of TRIESTE

(started on the academic year 2000/2001)

BME Courses	CFU	Year
Physiology	3	
Bioengineering	3	II / I S
Biomaterials	3	II / II S
Biomedical Electronics	6	II / II S
Electrical Systems in the Hospitals	6	II / II S
Hospital Information Systems	3	II / II S
Artificial Organs and Prosthesis	3	III / II S
Biomedical Instrumentation	6	III / II S
Health Telematics and Telemedicine	3	III / II S

Legenda: in the field "Year", when specified, it is indicated the year (I, II or III) where the module is allocated and the correspondent Semester (S) or Trimester (T).