

Bioart Report Spain

Una de las muchas frases que podemos encontrar en la red para definir la Ingeniería Biomédica es la siguiente:

"Biomedical Engineering is located in that area where science does not discern between living and inert matter contributing to the ambitious goal of putting technology at the service of medicine, ultimately, at the service of human well-being and health"

El presente informe pretende reflejar las enseñanzas que bajo el nombre de Grado en Ingeniería Biomédica se imparten en España.

En primer lugar se presentan los planes de estudio correspondientes al grado en Ingeniería Biomédica de Universidad Politécnica de Madrid. De esta forma podemos ver la organización típica de los contenidos y la estructura de cuatro años académicos para los estudios de Grado (*Bachelor*). Todas las Universidades consultadas mantienen el mismo formato de cuatro años.

En cuanto a asignaturas optativas, se observan muchas diferencias; algunas Universidades ofrecen asignaturas optativas desde los primeros semestres mientras que otras concentran las asignaturas optativas agrupándolas en forma de itinerarios en el último año académico. Las asignaturas básicas (*ground courses*) suelen ser todas de 6 créditos. Las asignaturas optativas aparecen en la mayoría de los planes de estudios con 3 o 4 créditos.

Las tablas presentadas en los apéndices muestran los contenidos más habituales que podemos encontrar dentro de los estudios de Ingeniería Biomédica en España.

A partir de los planes de estudios de once universidades, tanto públicas como privadas, hemos agrupado las asignaturas de cada año académico intentando reflejar cómo se van introduciendo los distintos temas a lo largo de los cuatro años académicos que duran los estudios del Grado en Ingeniería Biomédica. Las asignaturas han sido ordenadas alfabéticamente para facilitar la búsqueda de una determinada asignatura. De esta forma, también resulta sencillo observar la ausencia de asignaturas que con los avances tecnológicos deberían ir incorporándose a los estudios de bioingeniería. El número que aparece a la derecha indica en cuántas Universidades que se ofrece la asignatura con el mismo nombre.

Toda la información se ha obtenido consultando la información ofrecida por las distintas Universidades en sus sitios web (año 2018). De esta forma y, respetando los nombres de las asignaturas tal y como aparecen en los planes de estudios consultados, hemos completado las tablas que se ofrecen a continuación. Está claro que, bajo nombres diferentes pueden esconderse contenidos idénticos y también que asignaturas con el mismo nombre (en distintas Universidades) pueden tratar temas diferentes. De todas formas consideramos que, salvo pequeñas excepciones, el nombre de una asignatura refleja bastante bien los contenidos tratados en ella.

En concreto, hemos recopilado la información correspondiente a las siguientes Universidades.

Universidad Politécnica de Madrid (UPM)

Universidad Carlos III (UC3)

Universidad Rey Juan Carlos (URJC)

Universidad Politécnica de Valencia (UPV)

Universitat de Barcelona (UB)

Universitat Politècnica de Catalunya

Universitat Internacional de Catalunya (UIC)

Universitat Pompeu i Fabra

Universidad de Navarra.

Universidad San Pablo CEU

Universidad de Mondragón.

Los planes de estudio del resto de universidades que ofrecen títulos en Ingeniería Biomédica son muy similares a los que se han empleado para este estudio. Por tanto, no hemos considerado necesario ampliar el número de Universidades.

Conclusiones Grado

A partir de los listados de asignaturas podemos observar la gran variedad de contenidos y asignaturas que encajan dentro de la ingeniería biomédica pudiendo estar muy alejadas unas de otras sobre todo en los últimos años. Por citar un ejemplo, pensemos en asignaturas como *Bigdata processing*, *Biomaterials*, *Physical Chemistry*, *Genomics*, *Neuroscience*, *Three-dimensional vision*, etc. Por tanto, vemos que dentro de un grado en ingeniería biomédica podemos encontrar contenidos muy diversos dependiendo del punto de partida y la especialización que busquemos. Así, a partir de cualquiera de las titulaciones de ingeniería tradicionales (electrónica, mecánica, telecomunicaciones, informática) puede desarrollarse una ingeniería biomédica añadiendo contenidos específicos principalmente de química y biología.

Conclusiones Master

Observando la gran variedad de asignaturas de la Tabla x, está claro que los estudios de master en bioingeniería permiten especializarse en áreas tremendamente diversas. Dependiendo de sus conocimientos previos y de los temas que más atractivos le resulten, un estudiante puede llegar mundo de la bioingeniería o continuar en él sus estudios eligiendo dentro de la gran variedad de oferta que existe en las universidades españolas. La mayoría de los cursos se imparten en inglés.

La bioingeniería es una de las áreas donde la investigación está en constante crecimiento provocando continuos avances. De esta forma, las Universidades están obligadas a ofrecer nuevos contenidos e incorporar materias novedosas en sus planes de estudio. En algunos casos, los nombres de las asignaturas pueden parecer sacados de un libro de ciencia ficción: *'Bionic members'*, *'Intelligent sensors in artificial implants'*, *'3D printing of human organs'*, *'Energy harvesting for intelligent implants'* etc. Sin embargo, dichos temas ya son una realidad y deben ir apareciendo en los estudios de master para ser competitivos con las mejores universidades internacionales.

Universidad Politécnica de Madrid (UPM) Grado en Ingeniería Biomédica

Bachelor of Biomedical Engineering is a: 4-year course; 240 ECTS.

Full curriculum Biomedical courses – B. Sc Level

Universidad Politécnica de Madrid (UPM) Biomedical Engineering	Semester	Type	Credits
Mathematics I	1	mandatory	6
Physics I	1	mandatory	6
Chemistry	1	mandatory	6
Biology	1	mandatory	6
Programming Fundamentals	1	mandatory	6
Statistics	2	mandatory	6
Mathematics II	2	mandatory	6
Structural Biochemistry	2	mandatory	6
Cell and tissue biology	2	mandatory	6
Physics II	2	mandatory	6
Instrumental Analysis	3	mandatory	6
Economics and management	3	mandatory	6
Mathematics III	3	mandatory	6
Fundamentals of Biomechanics	3	mandatory	6
Fundamentals of Electronics	3	mandatory	6
Professional English	4	mandatory	6
Biomechanics of continuous media	4	mandatory	6
Systems Physiology	4	mandatory	6
Signals and Systems	4	mandatory	6
Electronic Systems	4	mandatory	6
Biomedical Signals	5	mandatory	6
Human Pathophysiology	5	mandatory	6
Numerical models in biomedicine	5	mandatory	6
Communication Networks	5	mandatory	6
Algorithms and data structures	5	mandatory	6
Databases	6	mandatory	6
Bioinstrumentation	6	mandatory	6
Biomedical Imaging	6	mandatory	6
Biomaterials	6	mandatory	6
Computer Architecture and Operating Systems	6	mandatory	6

Tracks:

Track 1: Bioengineering medical devices, biomaterials and biomechanics.

Itinerary in Bioengineering: medical devices, biomaterials and biomechanics.	Semester	Type	Credits
Biomedical Imaging Laboratory	7	specialization	4
Clinical and management engineering	7	specialization	4
Modelling and dynamic simulations applied to biomedicine	7	specialization	4
Biomedical signals Laboratory	7	specialization	4
Bioinstrumentation Laboratory	7	specialization	4
Biological tissue Engineering	7	specialization	4
Biological materials and biomaterials Laboratory	8	specialization	4
Biosensors	8	specialization	4
Biomechanics Laboratory	8	specialization	4
Medical device Development	8	specialization	4
Optional or elective credits (*)	8		
GRADUATION PROJECT	8		12

Track 2: Telemedicine

Itinerary in Telemedicine	Semester	Type	Credits
Clinical Engineering and health systems administration	7	specialization	4
Biomedical Information Systems	7	specialization	4
Modelling and dynamic simulations applied to biomedicine	7	specialization	4
Communication networks and services	7	specialization	4
Biomedical Image processing	7	specialization	4
Human machine interfaces	7	specialization	4
Health Records, Terminologies and Standards	8	specialization	4
Medical decision making tools	8	specialization	4
Telemedicine	8	specialization	4
Telemedicine Laboratory	8	specialization	4
Optional or elective credits (*)	8		
GRADUATION PROJECT	8		12
Neurosensorial Engineering	8	Optional	4

Itinerary in Biomedical Informatics	Semester	Type	Credits
Clinical Engineering and health systems administration	7	specialization	4
Biomedical Information Systems	7	specialization	4
Bioinformatics	7	specialization	4
Web technologies in biomedicine	7	specialization	4
Databases and Health Care System	7	specialization	4
Health Records, Terminologies and Standards	8	specialization	4
Medical decision making tools	8	specialization	4
Data mining in Biomedicine	8	specialization	4
NLP and Information Retrieval	8	specialization	4
E-health	8	specialization	4
Optional or elective credits (*)	8		
GRADUATION PROJECT	8		12

Track 3. Biomedical Informatics

Track 4: Medical Imaging

Itinerary in Medical Imaging	Semester	Type	Credits
Biomedical Information Systems	7	specialization	4
Modeling and dynamic simulations applied to biomedicine	7	specialization	4
Advanced medical imaging I	7	specialization	4
Blomedical Imaging Laboratory	7	specialization	4
Clinical Engineering and health systems administration	7	specialization	4
Medical Image processing	7	specialization	4
Health Records, Terminologies and Standards	8	specialization	4
Telemedicine	8	specialization	4
Surgical simulation and planning	8	specialization	4
Advanced medical imaging II	8	specialization	4
Optional or elective credits (*)	8	specialization	
Graduation project			12
Biophotonics	8	Optional	4
Neurosensory Engineering	8	Optional	4
Lab. of Telemedicine	8	Optional	4

* Elective credits can be taken as any combination of the following options: a) 2 courses from any of the GIB tracks; b) practicum credits (from 2 to 8 ECTS); c) activities taken from the Academic Commission approved list (up to 6 ECTS)

List of courses offer in the Bachelor Degree studies. First year	
	1
Algebra	2
Algebra and Multivariable Calculus	1
Algorithms and Data Structures	1
Anatomy and Physiology	1
Anthropology	1
Basic concepts on Biomedical Engineering	1
Bioelectromagnetism	1
Biology	3
Biomaterials and Biocompatibility	2
Biomechanics	2
Biophysics	2
Calculus	10
Cell and Molecular Biology	5
Cell and tissue biology	1
Chemistry/Biochemistry	11
Computational Techniques in Biomedicine	1
Computer Engineering and Networks	3
Computer Programming	5
Deontology, Health Legislation and Bioethics	1
Differential equations and vector calculus	1
Electrical Systems	1
Fundamentals of Electromagnetism, optics and atomic physics	2
Graphic Expression	3
History and Society	1
History of Biomedical Engineering	1
Human Morphology	1
Introduction to Bioengineering	2
Linear algebra and geometry	3
Materials Science and Technology	2
Mathematical Biomodeling	1
Mathematics	7
Mechanical Systems	3
Methodological Foundations	1
Morphology and function of the human body	1
Physics	9
Principles of Biological Design	1
Statistics	1
Structural Biochemistry	1
The role of biomedical engineering	1
Waves, Electrostatics and Thermodynamics	2

List of courses offer in the Bachelor Degree studies. Second year	
	1
Analog and Digital Electronics	1
Anatomy and Physiology	1
Applied Pathology	1
Bases of diagnosis and treatment in medical-surgical pathology	1
Biochemistry and Molecular Biology	3
Biocomputing	2
Biology	2
Biomaterials	2
Biomechanical Instrumentation	1
Biomechanics	6
Biomedical Imaging Systems	1
Biomedical Signal and Image Processing	1
Biomedical Signal Processing and Control	1
Biophysics	1
Biosignals and Biosystems	1
Biostatistics	2
Business and economy	2
Cell and Tissue Engineering	1
Challenges of Companies in the 21st Century	1
Circuit Theory	1
Computational Biology	1
Computer Networks	1
Databases	1
Differential Equations	2
Digital Electronics	1
Discrete Time Systems	1
Dynamical Systems in Biomedical Engineering	1
Economics and management	1
Electrical Systems	1
Electromagnetism and Optics	1
Electronic Systems	6
Engineering and Social Changes	1
English	1
Environmental Technologies and Sustainability	1
Evolutionary Algorithms	1
Fluid Mechanics	1
Health Economics	1
Histophysiology	1
Hospital management and clinical engineering	1
Human Anatomy	1
Human Physiology	1
Industrial Control and Automation	1
Instrumental Analysis	1

Linear Systems and Circuit Applications	1
Manufacturing technologies	1
Materials	3
Mathematical Biomodeling	1
Mathematical Methods of Bioengineering	4
Mechanical systems	2
Medical and Surgical Pathology I	1
Medical Instruments, Prosthesis and Implants	1
Numerical methods in biomedicine	1
Physics III	2
Physiology	4
Probability and statistics	1
Psychosocial Care	1
Radiotherapy and radiation protection	1
Regenerative medicine	1
Reverse Engineering and CAM	1
Scientific and Technical English	1
Scientific Communication Project	1
Sensors and Communication Networks	1
Signals and Systems	4
Statistics	3
Techniques for the Configuration of Materials	1
Technology and Society	1
Thermodynamics and Heat Transfer	1

List of courses offer in the Bachelor Degree studies. Third year (including optional and specialization courses)	
Advanced Microbiology	1
Advanced Microtechnology and Nanotechnology	1
Algorithms and data structures	1
Anatomy and Physiology I	2
Bioelectricity	1
Bioethics and deontology	1
Bioinstrumentation	1
Bioinstrumentation and biosensors	1
Biological Dynamic Systems Analysis	1
Biomaterials	4
Biomechanics	2
Biomedical Equipment	2
Biomedical Image Processing	7
Biomedical Information Transmission and Coding Systems	1
Biomedical Signal Processing	5
Biomedical Systems Prototyping Laboratory	1
Bioreactors y Bioprocesses	1
Biostatistics	1
Biotechnology and nanotechnology	1
Clinical Engineering	1
Communication Networks	1
Computational Modelling of Biological Systems	1
Computer Architecture and Operating Systems	3
Control and Robotics Technology	2
Control Theory and Self-Regulation	1
Data Processing	1
Databases	1
Digital Signal Processing	1
Digital Systems	1
Electronics	1
Engineering Design	1
Entrepreneurship and Innovation in Biomedical Engineering	3
Feedback Control in Biomedicine	1
Fundamental of tissue engineering and regenerative medicine	1
General Pathology	1
Health Information Systems	1
Hospital Engineering	2
Human Pathophysiology	1
Image processing and reconstruction	1
Imaging Techniques in Biomedicine	1
Industrial Design of New Products	1
Inference	1

Information Systems and Communications for Health Services	1
Information Systems in Health	1
Introduction to Biomaterials	1
Introduction to the design of medical instrumentation	1
Management of Health Units	1
Measuring Instrumentation	1
Mechanical Design of Medical Equipment	1
Medical and Surgical Pathology	1
Medical Certifications and Standards	1
Medical equipment manufacturing	1
Medical Imaging Systems	1
Medical Technological Equipment	1
Microtechnology and Nanotechnology	1
Modelling and Simulation Techniques	1
Monitoring, Diagnostic and Therapeutic Equipment	1
Numerical methods	2
Numerical models in biomedicine	1
Optimization	1
Organs and Systems Modelling	1
Pathophysiology and General Pathology	1
Pharmacology	1
Physiological Signal Processing	1
Physiopathology	1
Professional Placement II	1
Project Management and Innovation in Biomedical Engineering	1
Projects in Biomedical Engineering	1
Protein Engineering	2
Random Signals	1
Remote Diagnosis and Treatment Laboratory	1
Robotics	1
Safety in Hospitals	1
Sensors and Signal Conditioners	1
Signals and Systems	1
Tissue Engineering	1
Transport phenomena in biomedical engineering	1

List of courses offer in the Bachelor Degree studies. Fourth year	
(including optional and specialization courses)	
Adaptation in Prefabricated Orthotics-Prosthetics	1
Adaptation of Support Products and Mobility	1
Advanced Analysis of Biomedical Images (Cardiovascular system) : Segmentation and Quantification	1
Advanced Analysis of Neuronal Signals	1
Advanced Computer-Aided Design	1
Advanced medical imaging	2
Advanced Statistics and Applications in Engineering	1
Advanced Synthetic Biology	1
Advanced topics in medical image	1
Aesthetics Restorations and Coatings	1
Aging and the Third Age	1
Applications of Digital Electronics Systems	1
Applied Photonics	1
Artificial Intelligence and Learning	1
Artificial Intelligence for Engineering	1
Assistive technologies	1
Automatic Learning and Data Mining	1
Automatic Systems in Integrated Manufacturing	1
Basic Genetics	1
Big Data Processing	1
Bioinformatics	5
Bioinstrumentation Laboratory	1
Biological materials and biomaterials Laboratory	1
Biological tissue Engineering	1
Biomaterials	1
Biomaterials experimental design	1
Biomechanics	1
Biomechanics and medical pathology	1
Biomechanics and Surgical Pathology	1
Biomechanics Laboratory	1
Biomedical applications of nanotechnology	1
Biomedical Devices	1
Biomedical Ethics	1
Biomedical Image processing	3
Biomedical Imaging Laboratory	3
Biomedical Implants	1
Biomedical Information Systems	3
Biomedical instrumentation	3
Biomedical Microdevices	1
Biomedical signal and image analysis	2
Biomedical signals Laboratory	1

Biophotonics	1
Biophysics: Molecular Spectroscopy	1
Biosensors	1
Biostatistical Learning	1
Business Administration and Management	4
Cell culture and biotechnology for tissue engineering	1
Climate Change: Science, Energy, Economics, Politics and the Future	1
Clinical and management engineering	1
Clinical Engineering and health systems administration	4
Clinical Medicine	1
Cognitive Neuroscience	1
Commercial Engineering	1
Communication Electronics	1
Communication in Technical English	1
Communication networks and services	1
Companies, Entrepreneurship and Society	1
Computational Cardiology	1
Computational Engineering	1
Computational Neuroscience	1
Creation and Adaptation of External Prosthesis	1
Data mining in Biomedicine	3
Data Processing in Engineering	1
Databases and Health Care System	1
Decision support systems	1
Design and Implementation of Electronics Prototypes	1
Design Validation	1
Design, Creativity & Innovation	1
Developmental Biology	1
Devices for diagnosis and therapy	1
Earthquake Engineering and Structural Dynamics	1
E-health	1
Electronics System Technology for Control	1
Entrepreneurship and Industrial Ownership	1
Epidemiology and Health Technology Assessment	1
Ethics	1
Expertise Valuations and Authorizations	1
External Practices 1 (Hospitals and Health)	1
External Practices 2 (Biomedical Technology Transfer)	1
Face and Gesture Analysis	1
Facilities Projects	1
Full Prosthesis	1
Functional Design of Prosthesis	1
Games and Decisions	1
Genomics	2
Health Records, Terminologies and Standards	3
Healthcare Organization and Regulation	2
Hospital practices	1
Human machine interfaces	1
Imaging for Planning and Guidance of Minimally Invasive Surgery	1
Industrial Measurement Systems	1

Industrial Technology Applied to Prosthetic Activity	1
Informatics and Biotechnology to support tissue engineering	1
Information systems and telemedicine	2
Innovation Management	2
Instrumentation and Multimodality Imaging	1
Interdisciplinary Seminars	1
Introduction to biomedical imaging	1
Introduction to Medical Devices and their Design	1
Introduction to Pharmacy Research and Development	1
Leadership and Management	1
Management Skills	1
Material Elasticity and Strength	1
Mechatronics	1
Medical decision making tools	2
Medical device Development	1
Medical Image Analysis	1
Medical instrumentation and devices	1
Medical Technology Evaluation. Technical, Ethical and Social Aspects	1
Microbiology and Bioprocesses Laboratory	1
Microcontrollers in Process Automation	1
Micro-Nanotechnology	1
Minimally Invasive Technology	1
Mobile Devices Programming	1
Modelling and Simulation of Dynamical Systems	6
Modelling Complex Diseases	1
Movement Simulation	1
Musculoskeletal modelling	1
Neuroscience	1
Neurosensory Engineering	2
NLP and Information Retrieval	1
Numerical Simulation Applied to Engineering	1
Orthodontics and Occlusal Splints	2
Partially Removable Metallic Prosthesis Made of Resin and Mixed Materials	1
Personal health systems Technologies	1
Physical Chemistry	1
Planning, Programming and Control Project	1
Plastic Materials Technology	1
Prevention of Occupational Hazards	1
Programming for Engineers	1
Project Engineering & Management	1
Projects and Manufacturing	1
Prosthesis Laboratory	1
Renewable Energy and Energy Planning	1
Restorations and Metallic Structures in Fixed Prosthesis	1
Science and Technology Policies	1
Surgical simulation and planning	1
Synthetic Image	1
Systems Biology	2
Technical English for Engineers	1
Technology and Sciences in Ancient Times: Egypt and Mesopotamia	1

Telecommunications and Internet	1
Telemedicine	3
Telemedicine Laboratory	2
Thermal and Fluid Engineering	1
Three-dimensional Vision	1
Tissue Engineering	1
Tissue Engineering and Regenerative Medicine	1
Training in Companies Orthotics/Ortho-prosthetics/Bioengineering	1
Transport Phenomena	1
Value-Added Productivity with a PC	1
Virology	1
Web technologies in biomedicine	1

Master degree courses.

The following subjects and courses summarize the most common curricula for a Master level in Biomedical Engineering.

First, as an example of the typical organisation of the studies, we introduce the master program of the UPM. Then, the complete collection of courses found in the offer of the following universities is listed in a table.

Universitat de Barcelona

Universitat Politècnica de Catalunya

Universidad de Zaragoza

Universidad Politécnica de Madrid

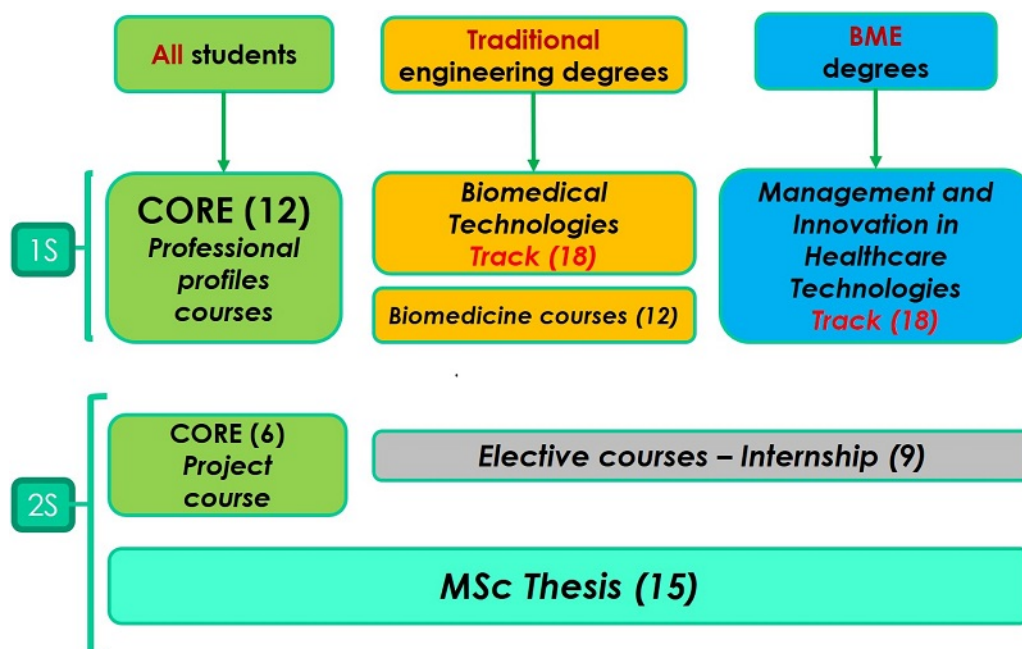
Universidad Politécnica de Valencia

Universidad San Pablo CEU

Universidad de Navarra

Universidad de Mondragón

Program of the UPM



Universidad Politécnica de Madrid (UPM) MSc in Biomedical Engineering	Semester	Type	Credits
Biomedical technologies design	1	Compulsory	3
Health technology business management	1	Compulsory	3
Biomedical engineering research and development projects	1	Compulsory	3
Telemedicine	1	Op track1	3
Bioinstrumentation	1	Op track1	3
Biomedical images	1	Op track1	3
Biomedical signals	1	Op track1	3
Biomechanics	1	Op track1	3
Entrepreneurship and innovation in biomedical engineering	1	Op track2	3
Medical data intelligent analysis	1	Op track2	3
Control and robotics in medicine	1	Op track2	3
Personalized medicine	1	Op track2	3
Advance methods in signal and medical	1	Op track2	3
Nanomedicine technologies	1	Op track2	3
Clinical seminars	1	Compulsory	3
Biomedical engineering professional projects	2	Compulsory	6
Biomedical signals laboratory	2	Op	3
Medical imaging laboratory	2	Op	3
Ambient intelligence	2	Op	3
Telemedicine laboratory	2	Op	3

Track 1: Biomedical Technologies.

Track 2: Management and Innovation in Healthcare Technologies.

MASTER (M. Sc. Level)	
Collection of courses offer in eight different Spanish Universities	
(Including optional and specialization courses)	
Advance methods in signal and medical	1
Advanced biomechanical techniques for the analysis of boy functions	1
Advanced Biomedical Signal Processing	3
Advanced Biosignal Treatment	1
Advanced Medical Imaging	2
Advanced Pattern Recognition Techniques	1
Advanced tissue engineering and regenerative therapy	1
Advanced treatment of biomedical signals	1
Algorithms, design and analysis of experiments.	1
Analysis and Statistical Computing of Biomedical Data	1
Analysis of genomic data	1
Analysis of medical images	1
Analysis of metabolic and proteomic data	1
Application of ""omic"" technologies in the diagnosis of complex diseases and the development of new drugs	1
Applications of the genomics, proteomics and HTS	1
Applied statistics in biomedical problems	1
Automation of Biomedical Systems	1
Big Data and biomedical sciences	1
Big data: parallel programming	1
Bioelectricity and electrophysiology	2
Bioelectronics	1
Bioengineering of the respiratory system	1
Bioethics	1
Biofluid mechanics	1
Bioinformatics and Computational Biology	3
Bioinformatics and Next Generation Sequencing	1
Bioinstrumentation	1
Biological interactions of biomaterials	1
Biomaterials and biomechanics	3
Biomechanical Design and Analysis	1
Biomechanical modelling of the cardiovascular system	1
Biomechanics	2
Biomechanics and Biomaterials	1
Biomechanics of human motion	1
Biomedical engineering research and development projects	2
Biomedical imaging technologies	3
Biomedical instrumentation	1
Biomedical signal and image processing	5
Biomedical signals laboratory	1
Biomedical systems and equipment design	2
Biomedical technology	2
Bionic rehabilitation techniques	1
Biophotonics	1

Bioprocesses	2
Biosensors (Lab on a Chip)	1
Biostatistics and numerical simulation of biomedical engineering	1
Biosystems and Nanobioengineering	1
Biotechnology laboratory	1
Cell mechanobiology	1
Computer aided prosthesis and implant design	1
Computer systems and networks	1
Computer vision perception	1
Control and robotics in medicine	3
Control Systems and Embedded Analysis Laboratory	1
Data quality and interoperability	1
Design and validation of surgical implants	1
Design and validation of technical aids	1
Design of Biomedical Autonomous Systems and Equipment	1
Design of biomedical embedded systems	1
Design of communication systems. Internet of things.	1
Design of prosthesis, orthosis and implants	1
Development of New Technology-Based Firms (NTBFs)	1
Digital Image Processing	1
Economics, Policy and Management of Biomedical Research	1
E-Health systems	2
Electromagnetics and health	1
Embedded systems in biomedicine	1
Enabling technologies: omic technologies	1
Entrepreneurship and innovation in biomedical engineering	2
Ergonomics and disability	1
Ergonomics and evaluation of functional capacity	1
Evidence-Based Medicine: Systematic Review in the Health Sciences	1
Fluid Mechanics and Computational Fluid Dynamics	1
Fundamentals of Anatomy, Physiology, Pathology and Therapeutics	1
Future, emerging technologies	1
Genetic data analysis	1
High Performance Computing	1
Hospital information systems	1
Human-Machine Interfaces	1
Image analysis in biomedicine	1
Implants	1
Information systems in medicine	2
Innovation and entrepreneurship in Biomedical Engineering	1
Innovation and research in medical technology	1
Innovation in the pharmaceutical industry: Advanced Medicines and Biotechnology	1
Intelligent Chemical Instrumentation	1
Laboratory of Genetic Engineering and Cell and Tissue Bionengineering	1
Large medical equipment	2
Management of Innovative Organizations	1
Materials and surface treatments for prosthesis and implants	1
Mechanisms of control and regulation of the body functions	2
Medical data intelligent analysis	1

Medical foundations	1
Medical imaging capture techniques	1
Medical imaging laboratory	1
Medical robotics and robotic exoskeleton	2
Medical signals	1
Micro and Nano-bioengineering	1
Modelling the mechanical behaviour of muscular skeletal tissue	3
Modelling and Simulation	2
Modelling and simulation of bioelectric systems	1
Models and systems of physiological control	1
Molecular imaging	1
Morphology	2
Motion capture and characterisation	1
Nano-bioengineering	1
Nano-biomedicine: Fundamentals and applications	1
Nano-diagnosis	1
Nano-diagnostics and Nano-therapy	1
Nanomedicine technologies	1
Nanoparticles in medical imaging and drug delivery	1
Nanotechnology and Biomedical Engineering	2
Nano-therapy	1
Neural engineering	2
Omics platforms in personalized medicine	1
Operations management	1
Optical technologies in biomedicine	1
Organization and Management of Clinical Information	1
Pathology	1
Pattern recognition techniques	1
Personalized medicine	1
Preclinical and clinical research. Design of experiments	1
Predictive analytics in health	1
Production of Scientific Texts	1
Projects, quality and intellectual property management	1
Quality management and certification of medical products	1
Quality Processes in the Biomedical Industry. Regulatory Basis	1
Quantification techniques in clinical analysis	1
Quantitative Research Methods	1
Radiation therapy technology	1
Regenerative medicine	2
Remote Monitoring Device design	1
Sanitary models	1
Scaffolds and tissue engineering	1
Scientific visualization and representation techniques	1
Surgical Planning and Training	1
Synthetic biology	1
Telecommunication systems in hospitals	1
Telemedicine	2
Therapeutic technologies	1
Tissue Engineering and Regenerative Medicine	2

Two- and Three-Dimensional Medical Images Processing	1
Visualization of Two- and Three-Dimensional Medical Images	1
Wireless Networks	1