MASTER IN BIOLOGICAL AND MEDICAL SCIENCES

Concentrations :

Biomechanics and Medical Imaging
Genetics and Molecular Biology
Neuroscience
Physiology and Physiopathology
Cancerology and Carcinogenic Agents

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campus Where the Program Is Offered: CSM

OBJECTIVES

The Master in Biological and Medical Sciences aims to train students to adopt a reflective and analytical approach by introducing them to research in the most competitive fields of life sciences and health. This program enables medical students to pursue doctoral studies (PhD), combine an academic career with clinical practice, and/or join a specialized research center (health and medicine).

The Master in Biological and Medical Sciences comprises 5 concentrations:
1) Physiology and Physiopathology
2) Neuroscience
3) Genetics and Molecular Biology
4) Cancerology and Carcinogenic Agents
5) Biomechanics and Medical Imaging

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

- Scientific: Using biological and medical knowledge and acquired skills in your research
- Communicator: Communicating results effectively with members of the research team
- Collaborator: Working with members of the research team
- Manager: Using research tools
- Ethics: Assume responsibility for scientific integrity

ADMISSION REQUIREMENTS

Candidates are selected based on the examination of an official form submitted with required documents to the academic secretary's office and following an oral interview.

- Admission to Master 1 (first and second semester of The Master in Biological and Medical Sciences): Open to USJ medical students having completed and validated their first cycle of medical studies and started the second cycle, and/or specialty residents and/or practicing doctors.
- Admission to Master 2 (third and fourth semesters)
  - USJ Medical students who have completed Master 1, selected based on performance.
  - USJ pharmacy students who have obtained their pharmacy diploma and completed Master 1 at their faculty, provided the chosen option is not offered in their own faculty.
  - USJ students from the Faculty of Sciences who have obtained their Bachelor and Master 1 from their faculty, provided the chosen option is not offered in their own faculty.

COURSES/CREDITS GRANTED BY EQUIVALENCE

Master 1 (First and second semesters)
For SCMS students, 30 credits are granted by equivalence from the FCMS curriculum. These are: Biomedical Statistics (2 Cr.). Metabolic Biochemistry (2 Cr.). Nutrition and Metabolism in Healthy Humans (2 Cr.). Fundamental Immunology (3 Cr.). English for Specific Purposes: Health Studies (4 Cr.). Introduction to Pharmacology (3 Cr.). Medical Bacteriology (3 Cr.). Medical Parasitology and Mycology (2 Cr.). Physiology of Aging (3 Cr.). Medical Virology (2 Cr.). Mental Health (2 Cr.). Biomechanical Disorders (2 Cr.).

For residents and physicians, 35 credits are awarded by equivalence from the FCMS curriculum and the specialty exam. These are: Biomedical Statistics (2 Cr.). Metabolic Biochemistry (2 Cr.). Nutrition and Metabolism of Healthy Humans (2 Cr.). Basic Immunology (3 Cr.). English for Specific Purposes: Health Studies (4 Cr.). Introduction to Pharmacology (3 credits). Medical Bacteriology (3 Cr.). Medical Parasitology and Mycology (2 Cr.). Physiology of Aging (3 Cr.). Medical Virology (2 Cr.). Mental Health (2 Cr.). Introduction to Biophysical and Biomechanical Disorders (2 Cr.). Specialized Medicine (5 Cr.).

For students coming from the SCMS, three closed optional courses, each worth five credits, will be chosen from the proposed list, for a total of 15 credits.
For residents and practicing physicians, two closed optional courses, each worth five credits, will be chosen from the list provided, for a total of 10 credits. (One course entitled "Specialized Medicine" is granted by equivalence and is added to the 30 credits previously granted).

PROGRAM REQUIREMENTS

120 credits: Required courses (105 credits), Institution's elective courses (15 credits).

Master 1 (First and Second Semesters) (60 Cr.)

Required Courses (45 Cr.) (30 Cr. granted from SCMS)
Courses granted from FSMS are: Biomedical Statistics (2 Cr.). Metabolic Biochemistry (2 Cr.). Nutrition and Metabolism in Healthy Humans (2 Cr.). Fundamental Immunology (3 Cr.). English for Specific Purposes: Health Studies (4 Cr.). Introduction to Pharmacology (3 Cr.). Medical Bacteriology (3 Cr.). Medical Parasitology and Mycology (2 Cr.). Physiology of Aging (3 Cr.). Medical Virology (2 Cr.). Mental Health (2 Cr.). Biomechanical Disorders (2 Cr.). Specialized Medicine (5 Cr.).
15 Cr. from the 30 Cr. granted are required: Methodology and Ethics in Fundamental Research (5 Cr.); Observation and Research Initiation Course (10 Cr.).

Elective courses (15 Cr.).
Biomechanics and Medical Imaging: Gait Analysis and Study of the Human Skeleton (5 Cr.); Genetics and Molecular Biology: Oncogenetics, Karyotyping and Techniques (5 Cr.); Molecular and Cellular Pathophysiological Basis of Human Diseases (5 Cr.); Neuroscience: Neuromodulation of Pain (5 Cr.); Cancer Cell Metabolism and their Signaling Pathways (5 Cr.); Public Health Policies and Systems (5 Cr.).

Master 2 (Third and Fourth Semesters) (60 Cr.)
Required Courses - Common Core (10 Cr.)
Scientific Research Methodology (3 Cr.). Biostatistics (2 Cr.). Biotechnology (1 Cr.). Introduction to Laboratory Work (1 Cr.). Bioinformatics (1 Cr.). Cellular Biology (2 Cr.).

Required Courses - Courses of the specific core (10 Cr.). One specific core per concentration and per the laboratory of research. Concentrations are:

Required Courses – Specific Core - Concentration: Physiology and Physiopathology (10 Cr.)
Experimental Physiology (2 Cr.). Introduction to Channelopathies (2 Cr.). Physiology and Pharmacology of Membrane Transporters (2 Cr.). Stress and Heart (2 Cr.). Stress and Kidney (2 Cr.).

Required Courses – Specific Core - Concentration: Biomechanics and Medical Imaging (10 Cr.)

Movement Analysis (3 Cr.). 3D Reconstruction of the Skeleton (4 Cr.). Data Analysis, Presentation of Results and Medical Writing (3 Cr.).

Required Courses – Specific Core - Concentration: Cancerology and Carcinogenic Agent (10 Cr.)
The Biology and Nature of Cancer (2 Cr.). The Characteristics of Cancer Cells (2 Cr.). Metabolism of Cancer Cells (2 Cr.). Techniques Molecular and Cellular Biochemistry (2 Cr.). Analysis of Articles and Writing of Research Projects (2 Cr.).

Required Courses – Specific Core - Concentration: Neuroscience (10 Cr.)
Pain: Normal and Pathological Neurobiology (2 Cr.). Pain Management (2 Cr.). Unraveling the Mystery of the Insula Lobe (1 Cr.). Cognitive Neurosciences (2 Cr.). Neurostimulation for the Treatment of Pathologies of the Nervous System (2 Cr.). Electrophysiology of the Nervous System (1 Cr.).

Required Courses – Specific Core - Concentration: Genetics and Molecular Biology (10 Cr.)
Molecular Bases of Pathologies (2 Cr.). Oncogenetics (2 Cr.). New Technologies Workshops (2 Cr.). Therapies and Personalized Medicine (2 Cr.). Imprinting and Genomic Regulation (2 Cr.).

Research Thesis (10 Cr.)

Research Internship (30 Cr.).

SUGGESTED STUDY PLAN

Semester 1

30 credits are granted by equivalence from the FCMS

Code	Course Name	Credits
	Institution's Elective Courses	
002BIOMM2	Biomechanics and Medical Imaging: Gait Analysis and Study of the Human Skeleton	5
002CGENM2	Genetics and Molecular Biology: Oncogenetics, Karyotyping and Techniques	5
002BPCMM2	Molecular and Cellular Pathophysiological Basis of Human Diseases	5
002NEURM2	Neuroscience: Neuromodulation of Pain	5
002METAM2	Cancer Cell Metabolism and their Signaling Pathways	5
496PGSPM2	Public Health Policies and Systems	5
	Credits granted by equivalence from the FCMS	30
	Total	**45**

***** Choose 3 out of 6 courses for SCMS students and 2 for residents and physicians.

Semester 2

Code	Course Name	Credits
	Required Courses	
002MERFM2	Methodology and Ethics in Fundamental Research	5
002STAGM2	Observation and Research Initiation Course	10
	Total	**15**

Semester 3

Code	Course Name	Credits
	Required Course - Common Core	
002TCMSM8	Scientific Research Methodology	3

002TCBIM8	Bioinformatics	1
002TCTLM8	Introduction to Laboratory Work	1
002TCBTM8	Biotechnology	1
002TCBCM8	Cellular Biology	2
002TCEBM8	Biostatistics	2
Total		**10**
Required Courses – Specific Core - Concentration: Physiology and Physiopathology		
002PHECM3	Experimental Physiology	2
002INCAM3	Introduction to Channelopathies	2
002TSPPM8	Physiology and Pharmacology of Membrane Transporters	2
002STCOM3	Stress and Heart	2
002STREM3	Stress and Kidney	2
Total		**10**
Required Courses – Specific Core - Concentration: Biomechanics and Medical Imaging		
002ANDMM4	Movement Analysis	3
002RTDSM4	3D Reconstruction of the Skeleton	4
002ADRMM4	Data Analysis, Presentation of Results and Medical Writing	3
Total		**10**
Required Courses – Specific Core - Concentration: Cancerology and Carcinogenic Agents		
002BNDCM4	The Biology and Nature of Cancer	2
002CDCCM4	The Characteristics of Cancer Cells	2
002MDCCM4	Metabolism of Cancer Cells	2
002TBMCM4	Molecular and Cellular Biochemistry Techniques	2
002ADRMM4	Analysis of Articles and Writing of Research Projects	2
Total		**10**
Required Courses – Specific Core - Concentration: Neuroscience		
002DNNPM4	Pain: Normal and Pathological Neurobiology	2
002PECDM4	Pain Management	2
002LMLIM4	Unraveling the Mystery of the Insula Lobe	1
002NECOM4	Cognitive Neurosciences	2
002TPSNM4	Neurostimulation for the Treatment of Pathologies of the Nervous System	2
002EDSNM4	Electrophysiology of the Nervous System	1
Total		**10**
Required Courses – Specific Core - Concentration: Genetics and Molecular Biology		
002BMDPM4	Molecular Bases of Pathologies	2
002ONGEM4	Oncogenetics	2
002AENTM4	New Technologies Workshops	2
002TEMPM4	Therapies and Personalized Medicine	2
002EERGM4	Imprinting and Genomic Regulation	2
Total		**10**

Semester 4

Code	Course Name	Credits
002STLBM4	Research Internship	30
002MMIIM2	Research Thesis	10
	Total	**40**

COURSE DESCRIPTION

Required courses for M1

002MERFM2 Methodology and Ethics in Fundamental Research 5 Cr.

This course explains the steps and protocols required to conduct research projects on animals or humans. It covers ethical considerations, informed consent, the Declaration of Helsinki, the European directives for animal experimentation, and the Lebanese law on scientific research.

002STAGM2 Observation and Research Initiation Course 10 Cr.

This course allows students to visit all research laboratories of the Faculty of Medicine in groups, followed by a 20-hour observation period in each laboratory. Through these observations, students will learn about research dynamics and select their internship site for M2.

Common core courses for M2

002TCMSM8 Scientific Research Methodology 3 Cr.

This course explains and describes various techniques and tools used in a research laboratory across different biomedical disciplines. These include western blot, immunofluorescence, immunohistochemistry, GST Tag or His tag pull down, partner search (Double hybrid, Modeling), Co-immunoprecipitation, Proteomics, cell culture, immortalized cells, cell transfections, molecular cloning, transgenesis and applications, studies of Apoptosis and Necrosis, flow cytometry, animal models in medical research, qualitative PCR, RT-PCR, PCR in real time, Search for mutations, sequencing, restriction mapping, Southern blot, DNA microarrays, strategies for identifying new genes involved in pathology.

002TCEBM8 Biostatistics 2 Cr.

This course covers the identification and application of statistical tools in a research project. It explores topics such as statistics and probability: statistics, population and sample, mathematical reminders: set, elements, function, inverse function, integrals, random variables: representation of a finite probability law, mathematical expectation of a finite law, variance and standard deviation, product probability law. This course also examines examples of distributions: discrete laws, continuous laws, X2 law, Student's law, exponential law. Students will study fluctuations of the experimental mean (the experimental mean random variable): properties of the experimental average, study of the normal distribution, evaluation of the diagnostic interest of medical information: introduction (the diagnosis, medical information, experimental situation and estimation), the parameters of the evaluation (a representative sample, two samples representative), notion of decision support: notion of utility, decision trees, use of statistical software.

002TCBTM8 Biotechnology 1 Cr.

This course covers the following: the importance and contribution of biotechnology in research: Pharmaceutical biotechnology, identification of molecular targets and drug design in the field of cardiovascular, degenerative and inflammatory diseases as well as cancer; Bioprocesses: innovation and development of processes from design to industrial production by exploiting the use of microorganisms, enzymes and animal cells or insects as biocatalysts; Bio environment (Bio polymers, Bio pesticides, Bio surfactants); Plant and animal biotechnology

(Genetically Modified Organisms): production applications, public health issues; Tissue culture; Production of enzymes (Biomaterials).

002TCTLM8 Introduction to Laboratory Work 1 Cr.

This course explains the dangers of handling products, environmental protection measures, and good animal testing practices.

002TCBIM8 Bioinformatics 1 Cr.

This course explains the importance and contribution of bionformatics in research: research of gene and protein sequences. It covers the following topics: Search for primers; Base alignment; Prediction of 3D structures of proteins and their interactions with DNA or proteins; Mapping (distribution of genes on chromosomes); Comparison of the genomes of different organisms; Application: GMOs, bacteria, fungi, yeasts.

002TCBCM8 Cellular Biology 2 Cr.

This course explains the dynamics of the cell and its impact on the homeostasis of the organism: Reminder on the general organization of the eukaryotic cell (Cell biology methodologies); The Hallmarks of Cancer; In and Out of the cell (Cellular membranes, macro-domains and micro-domains, membrane transport); Cytoskeleton; Cellular dynamics; Molecular mechanisms; Cell-cell relationship and cell with its environment.

Concentration: Physiology and Physiopathology

002PHECM3 Experimental Physiology 2 Cr.

This course is delivered in the 4th semester and includes lectures and practical work. It integrates technical knowledge into the research internship, and develops appropriate experimental approaches.

002INCAM3 Introduction to Channelopathies 2 Cr.

This course is delivered in the 4th semester and includes lectures and practical work. It aims to develop knowledge on the experimental approach to the study of ion channels and their role in normal and pathological physiological processes.

002TSPPM8 Physiology and Pharmacology of Membrane Transporters 2 Cr.

This seminar is delivered in the 4th semester. It aims to develop knowledge on membrane transporters: nature, functions and pharmacological control.

002STCOM3 Stress and Heart 2 Cr.

This seminar is delivered in the 4th semester. It aims to develop knowledge of cardiac function when it is subject to metabolic and mechanical constraints.

002STREM3 Stress and Kidney 2 Cr.

This course is delivered in the 4th semester. It includes lectures and practical work. It aims to develop knowledge on renal function when it is subject to metabolic and mechanical constraints.

Concentration: Biomechanics and Medical Imaging

002ANDMM4 Movement Analysis 3 Cr.

This course develops knowledge of techniques and methodologies in musculoskeletal biomechanics, particularly important in fundamental and clinical research. It includes the use of movement acquisition equipment; Pre-acquisition calibration; Place markers on subjects; Static and dynamic acquisitions; Data processing on different software; Backup of data on different servers; Data extraction and clinical use; Proposal for medical treatment upon seeing the results.

002RTDSM4 3D Reconstruction of the Skeleton 4 Cr.

This course develops knowledge of techniques and methodologies in musculoskeletal biomechanics, particularly important in fundamental and clinical research: Use of tools for EOS radiography; Positioning of the subject during acquisition; Contribution to taking x-rays and transfer to different stations and servers; 3D reconstruction of the spine; 3D reconstruction of the lower limbs; 3D reconstruction of the pelvis; 3D reconstruction of the rib cage; 3D reconstruction of the cervical spine; 3D reconstruction of the healthy hip and the prosthetic hip; 3D reconstruction using the Posture module; Data extraction and clinical use.

002ADRMM4 Data Analysis, Presentation of Results and Medical Writing 3 Cr.

This course develops knowledge in statistical analyses, abstract writing, article writing, poster preparation and oral presentation preparation: Statistical analysis: choose suitable statistical tests, Use statistical software; Write an abstract for a conference; Write research manuscript; Prepare a poster; Prepare an oral presentation; Participate in various research meetings in the laboratory with the entire team: doctors, residents, doctoral students and interns.

Concentration: Cancerology and Carcinigenic Agents

002BNDCM4 The Biology and Nature of Cancer 2Cr.

This course aims to introduce students to the world of the cancer cells, including their initiation, progression, and genetic modifications. By the end of this course, students will be able to: know the necessary steps and the points of no return for the development of a cancer cell; know and understand the most probable and most studied causes of cancer at the molecular level; and understand the response of cancer cells to growth factors.

002CDCCM4 The Characteristics of Cancer Cells 2 Cr.

This course aims to explain the characteristics and behaviors that distinguish a cancer cell from a normal cell. This is essential to guide a research project and put it on the right track. By the end of this course, students will be able to: Know the specific characteristics of a cancer cell; distinguish the differences between a cancer cell and a normal cell; and understand the messy behavior of a cancer cell versus a normal cell.

002MDCCM4 Metabolism of Cancer Cells 2 Cr.

This course explores the significant differences between the metabolism of cancer cells and normal cells, highlighting how these metabolic changes can contribute to the initiation and progression of cancers. By the end of this course students will be able to: Know the difference between a normal cell and a cancerous cell; explain the Warburg effect and aerobic glycolysis; and establish the interrelationship between the anabolic pathways most activated in cancer cells.

002TBMCM4 Cellular and Molecular Biochemical Techniques 2 Cr.

This course aims to introduce students to the different basic techniques used in a cancer laboratory. By the end of this course, students will be able to: Explain and/or practice cell culture; Explain and/or practice DNA and RNA extraction; Explain and/or practice RT-PCR and qPCR; Explain and/or practice the SSCP; Explain and/or practice site-directed mutagenesis; Explain and/or practice protein electrophoresis.

002ARPRCM4 Analysis of Articles and Writing of Research Projects 2Cr.

This course aims to train students to write a research project and to read and analyze scientific articles. By the end of this course, students will be able to write and set up a research project, analyze a scientific article, and prepare and present scientific projects.

Concentration: Neuroscience

002DNNPM4 Pain: Normal and Pathological Neurobiology 2 Cr.

This course, offered in the third semester, includes lectures and critical analyses of scientific articles. It provides an

in-depth understanding of pain, a major topic in neuroscience and an important societal issue. Students will learn about pain classification, pathways, and control and modulation structures through the analysis of functional neuroimaging studies.

002PECDM4	**Pain Management**	**2 Cr.**

This course is delivered in the 3rd semester. It includes lectures and critical analysis of scientific articles, and develops the student's ability to think critically about science. Students will discuss various methods for managing pain, a significant issue in society and the field of neuroscience.

002LMLIM4	**Resolving the Mystery of the Insula Lobe**	**1 Cr.**

This course is delivered in the 3rd semester and analyses scientific articles. It plays a crucial role in the program, equipping students with bibliographic research skills, and developing a sense of synthesis. By the end of this course, students will be able to: Know the anatomical organization of the lobe of the insula; mention the different roles assigned to each subpart of the insula, describe the results of electrophysiological studies targeting the insula; and interpret the results of neuroimaging studies investigating the insula.

002NECOM4	**Cognitive Neurosciences**	**2 Cr.**

This course is delivered in the 4th semester and includes lectures and critical analysis of scientific articles. It plays a crucial role in Neuroscience teaching, particularly for the acquisition of the concepts of functional regionalization of the brain and connectivism. By the end of this course students will be able to: Describe the physiopathology of various memory processes; mention animal models and behavioral tests used to study Alzheimer's disease; know the principle of addiction as well as the reward system; describe the neurobiology of waking and sleeping states, as well as circadian rhythms; and recognize the role of the prefrontal cortex in the control of executive functions.

002TPSNM4	**Neurostimulation for the Treatment of Nervous System Pathologies**	**2 Cr.**

This course is delivered in the 4th semester and includes lectures and critical analysis of scientific articles. It plays a crucial role in Neuroscience teaching, for the acquisition of knowledge on neurostimulation techniques which are increasingly used in the neurosurgical environment for the treatment of various pathologies of the nervous system. Students will analyze the contributions of functional neuroimaging and electrophysiology in understanding the mechanisms of action of various neurostimulation techniques. By the end of this course, students will be able to identify the target structures in neurostimulation for the treatment of pain, abnormal movements, epilepsy, tinnitus, headaches, and psychiatric pathologies, as well as describe the mechanisms of action of these neurostimulation techniques.

002EDSNM4	**Electrophysiology of the Nervous System**	**1 Cr.**

This course is delivered in the 4th semester and includes lectures, journal club, and practical internships. It aims to provide students with a broad vision of the different electrophysiology techniques which make it possible to understand the nervous system from cellular aspects to the functionality of different structures. By the end of this course, students will be able to: Describe the principle of epidural stimulation and subdural stimulation; Recognize the means of achieving cortical, deep and peripheral stimulation; Know the principle of unitary extracellular recording in vivo; Analyze an electrophysiological trace; Apply electromyographic recordings; Know the general principles of various electrophysiological techniques.

Concentration: Genetics and Molecular Biology

002BMDPM4	**Molecular Bases of Pathologies**	**2 Cr.**
002ONGEM4	**Oncogenetics**	**2 Cr.**
002AENTM4	**New Technology Workshops**	**2 Cr.**
002TEMPM4	**Therapies and Personalized Medicine**	**2 Cr.**

002EERGM4	**Imprinting and Genomic Regulation**	**2 Cr.**

This program updates students' knowledge in clinical and molecular genetics and human pathologies, providing a deeper understanding of research and publication procedures before embarking on doctoral studies and engaging with leading scientists. Students will attend the European Society of Human Genetics (ESHG) conference held annually in Europe for 4-5 days (48 hours) in English, or the genetics conference which takes place every 2 years in France and is conducted in French. Attendance at these conferences is validated as credits for all students.

002MMIIM2	**Research Thesis**	**10 Cr.**

This research thesis presented at the end of the second year of this program (semester 4) describes the research work carried out by students, and is supported before a reading committee jury. It adheres to specific requirements in terms of presentation and writing.

002STLBM4	**Research Internship**	**30 Cr.**

This internship lasts 6 to 8 months and takes place in a research laboratory affiliated with the faculty of medicine. The work focuses on a research project related to the chosen concentration. The scientific direction is carried out by an authorized full-time instructor-researcher with the appropriate academic qualifications.