ULB UNIVERSITÉ LIBRE DE BRUXELLES

#### MA-IRCB | M-IRCBS | 2023-2024

# Master of science in Biomedical Engineering

Focus Professional

The programme is based on the standard three-year format: the third year of the Bachelor programme, followed by two years of a Master programme. Courses are given on the three following main subjects: biomechanics, biomedical instruments, and biomedical imaging. The 3rd year of the Bachelor programme provides basic knowledge in biomedicine and engineering. Then, the 1st year of the Master programme covers the basic material for all three main subjects, while the 2nd year has students choose a series of courses that align more closely with their interests in one of these subjects. Students may also choose to specialise in courses required to become an expert in medical radiophysics; this speciality will give them insight into the use and impact of ionising radiation (radiotherapy, scanners etc.) on living tissue.

#### Bachelor – Year 3

In addition to a common core of courses, 30 credits are specific to biomedical engineering: these specialised courses provide basic knowledge in biomedicine (biology, physiology, biochemistry, anatomy) and engineering (instruments, computing, and automation), later developed in the Master programme.

#### Master – Year 1

Courses are centred around a 'biomedicine' module (25 credits) and an 'engineering' module (30 credits), which cover the basics of the programme's three core subjects (biomechanics, instruments, imaging) in order to help students choose a specialisation in year 2 based on their personal interests.

The programme is completed by a specific project related to biomedical engineering (5 credits), which can take the form of a biomedical imaging project or a biomechanics project. Alternatively, selected students may complete one of two other types of projects: a biomedical project on development cooperation (see www.ulb.ac.be/facs/polytech/cooperation-Mission.html to learn more about these projects), and a 'team leader' project, where they will supervise a group of 1st-year Bachelor students for their own final project.

#### Master – Year 2

For the final year, the programme includes a dissertation, which counts for 20 credits, and three series of classes (modules), each of which is specialised in one of the three main subjects (biomechanics, instrumentation, imaging). By choosing at least 20 credits' worth of courses in two of the three modules, students can align their studies with their interests. Another possibility is to specialise in medical radiophysics, in order to prepare for additional training as an expert in this medical radiophysics.

Students may also complete a work placement (10 credits) in a company or a hospital, in Belgium or abroad, with an additional module and a free module, totalling at least 60 credits. In addition, students take part in 3 events (5 credits): the Biomedical Days (three days of talks hosted by a panel of speakers from the industrial sector, organised jointly with UCL and ULg), the National Day on Biomedical Engineering—including a biomedical job fair—, and the European Course on Laparoscopic Surgery.

Some courses are given in English (the actual number of hours depends on each student's choice of electives).

## Bloc 1 M-IRCBS MA-IRCB

## **ENGINEERING SCIENCE**

ELEC-H310	Digital electronics   Dragomir MILOJEVIC (Coordinator)         ③ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h]
ELEC-H402	Analog electronics François QUITIN (Coordinator) © 5 credits [lecture: 24h, practical work: 36h] 📋 second term 🔎 English
ELEC-H424	Active medical devices       Antoine NONCLERCQ (Coordinator)         Ø 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h]
INFO-H500	Image acquisition and processing Olivier DEBEIR (Coordinator) © 5 credits [lecture: 24h, practical work: 24h]   first term  Figure English
MEDI-H503	Orthopaedic biomechanics       Bernardo INNOCENTI (Coordinator)         O 5 credits [lecture: 48h, tutorial classes: 12h] <sup>(1)</sup> second term          C English
STAT-H400	Multivariate data analysis   Mehrdad TERATANI (Coordinator) ② 5 credits [lecture: 24h, tutorial classes: 24h] <sup>^</sup> first term <sup>^</sup> English

## **BIOMEDICAL SCIENCE**



BIME-H407	Introduction to medical imaging and optical microscopy   Olivier DEBEIR (Coordinator) and Simon-Pierre GORZA ③ 5 credits [lecture: 48h, tutorial classes: 12h]
BIME-H408	Histology and neurophysiology   Karelle LEROY (Coordinator), David GALL and Serge SCHIFFMANN ② 5 credits [lecture: 60h, practical work: 12h]
BIME-H409	Image: Human Physiology       Nicolas BAEYENS (Coordinator) and Gaël DEBOECK         Image: Stredits [lecture: 24h, practical work: 12h]       Image: Stredits [lecture: 24h, practical work: 12h]
INFO-H400	Medical Information Systems       DAVID WIKLER (Coordinator)         ③ 5 credits [lecture: 24h, tutorial classes: 24h, practical work: 12h]

# ENGINEERING PROJECT

1 project to chose out of these 4

## Project to choose

#### One course chosen from the following

MECA-H409	Design methodology   Alain DELCHAMBRE (Coordinator)
(optional)	② 5 credits [lecture: 24h, tutorial classes: 24h, personal assignments: 12h]
PROJ-H417 (optional)	Projet coopération au développement   Antoine NONCLERCQ (Coordinator)         ③ 5 credits [project: 150h]         简 first and second terms       > French         Only on selection : see the Development Unit of the Polytechnic School of Brussels (http://polytech.ulb.be/en/international/development-cooperation)
PROJ-H418	Hands-on learning: project manager (chef de projet)   Peter BERKE (Coordinator)
(optional)	② 5 credits [project: 150h]
PROJ-H419	Biomedical engineering project in image analysis   Olivier DEBEIR (Coordinator)
(optional)	② 5 credits [project: 150h] 👚 academic year 🔎 English



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# Master of science in Biomedical Engineering

## Bloc 2 | M-IRCBS | MA-IRCB

or

# Compulsory commun courses - Block 2

MEMO-H500	Master thesis in biomedical engineering       Bernardo INNOCENTI (Coordinator)         ② 20 credits [personal assignments: 600h]
PROJ-H500	Biomedical research and industry seminars   Olivier DEBEIR (Coordinator) ② 5 credits [lecture: 60h] 🛗 academic year 📿 English
An alternative ch	nosen from the five following
Option Bio	omechanics and instrumentation
	Choose a minimum of 20 credits from the modules 594 and 595
(with a min of 5	ECTS for a module)
A total of 20 ci	redits chosen from the following
	Module 594 - Biomechanics
MECA-H501 (optional)	Soft microrobotics Pierre LAMBERT (Coordinator) ③ 5 credits [lecture: 24h, practical work: 24h, personal assignments: 24h]
MEDI-H504 (optional)	Design of Orthopaedic Medical Devices : biomechanics, design and regulation Bernardo INNOCENTI (Coordinator) ③ 5 credits [lecture: 48h, tutorial classes: 12h]
MEDI-H508 (optional)	Fluid mechanics of the cardiovascular and pulmonary systems. From physiology to applications   Benoît HAUT (Coordinator)
	○ 5 credits [lecture: 24n, tutorial classes: 12n, practical work: 24n]
	Module 595 - Instrumentation
ELEC-H409 (optional)	<ul> <li>○ 5 credits [lecture: 12h, practical work: 36h]</li></ul>
ELEC-H410 (optional)	Real-time computer systems       François QUITIN (Coordinator)         ③ 5 credits [lecture: 24h, practical work: 36h]
ELEC-H503 (optional)	Artificial organs       Antoine NONCLERCQ (Coordinator)         ③ 5 credits [lecture: 24h, practical work: 36h] <sup>(1)</sup> second term <sup>(2)</sup> English
MATH-H509 (optional)	Biomedical robotics Emanuele GARONE (Coordinator) and Bernardo INNOCENTI 3 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 🛗 second term 📿 English
MEDI-H507 (optional)	Lab on a chip for biomedical applications Benoît SCHEID (Coordinator) and Gert DESMET ③ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h]



	Option Bior	nechanics and biomedical image analysis and informatics
••••••		Choose a minimum of 20 credits from the modules 594 and 596
:(	with a min of 5 cr	redits for module)
	A total of 20 crea	lits chosen from the following
		Module 594 - Biomechanics
	MECA-H501 (optional)	O 5 credits [lecture: 24h, practical work: 24h, personal assignments: 24h]
	MEDI-H504 (optional)	Design of Orthopaedic Medical Devices : biomechanics, design and regulation Bernardo INNOCENTI (Coordinator) ② 5 credits [lecture: 48h, tutorial classes: 12h] 🛗 first term 📿 English
	MEDI-H508 (optional)	Fluid mechanics of the cardiovascular and pulmonary systems. From physiology to applications Benoît HAUT (Coordinator) (Coordinator) © 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 🛗 first term 🔎 English
• • • • • •		Module 596 - Biomedical image analysis and informatics
	BINF-F401 (optional)	Computational Methods for Functional Genomics Vincent DETOURS (Coordinator) <ul> <li>5 credits [lecture: 36h, practical work: 24h]</li> <li>second term</li> </ul>
	INFO-H501 (optional)	Pattern recognition and image analysis       Olivier DEBEIR (Coordinator) and Christine DECAESTECKER         Image: Stredits [lecture: 36h, practical work: 24h]       Image: Stredits Coordinator (Coordinator) and Christine DECAESTECKER
	INFO-H502 (optional)	Virtual Reality   Gauthier LAFRUIT (Coordinator) ◎ 5 credits [lecture: 24h, practical work: 24h] 🛗 first term 🔎 English
	INFO-H503 (optional)	GPU computing Gauthier LAFRUIT (Coordinator) and Jan LEMEIRE ② 5 credits [lecture: 24h, practical work: 24h, project: 24h] 🛗 second term 🔎 English
	INFO-H516 (optional)	Visual Media Compression Mehrdad TERATANI (Coordinator) and Gauthier LAFRUIT ② 5 credits [lecture: 24h, practical work: 24h, personal assignments: 12h] 🗂 second term 📿 English
	MEDI-H401 (optional)	Radioprotection médicale, y compris les techniques de radiologie   Marc LEMORT (Coordinator) ② 2 credits [lecture: 12h, practical work: 12h] 🛗 second term 📿 French
	MEDI-H506 (optional)	Magnetic Resonance Imaging and Biomedical Nanotechnology   Gilles BRUYLANTS (Coordinator) and Thierry METENS

or

## Option Instrumentation and biomedical image analysis and informatics

## Choose a minimum of 20 credits from the modules 595 and 596

(with a minimum of 5 credits for module)

A total of 20 credits chosen from the following

#### Module 595 - Instrumentation

ELEC-H409	
(ontional)	

ELEC-H410	Real-time computer systems	François QUITIN (Coordinator)
	3 5 credits [lecture: 24h, practical work	rk: 36h]  🛗 second term 📿 English

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ELEC-H503 (optional)	Artificial organs       Antoine NONCLERCQ (Coordinator)         ③ 5 credits [lecture: 24h, practical work: 36h] <sup>(1)</sup> second term <sup>(2)</sup> English
MATH-H509 (optional)	Biomedical robotics Emanuele GARONE (Coordinator) and Bernardo INNOCENTI ② 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 🛗 second term 🔎 English
MEDI-H507 (optional)	Lab on a chip for biomedical applications Benoît SCHEID (Coordinator) and Gert DESMET ② 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h] 🛗 second term 🔎 English
	Module 596 - Biomedical image analysis and informatics
BINF-F401 (optional)	O 5 credits [lecture: 36h, practical work: 24h] <sup>m</sup> second term
INFO-H501 (optional)	Pattern recognition and image analysis       Olivier DEBEIR (Coordinator) and Christine DECAESTECKER         ③ 5 credits [lecture: 36h, practical work: 24h]
INFO-H502 (optional)	Virtual Reality       Gauthier LAFRUIT (Coordinator)         ③ 5 credits [lecture: 24h, practical work: 24h] <sup>(1)</sup> first term <sup>(2)</sup> English
INFO-H503 (optional)	GPU computing Gauthier LAFRUIT (Coordinator) and Jan LEMEIRE
INFO-H516 (optional)	Visual Media Compression │ Mehrdad TERATANI (Coordinator) and Gauthier LAFRUIT ② 5 credits [lecture: 24h, practical work: 24h, personal assignments: 12h]
MEDI-H401 (optional)	Radioprotection médicale, y compris les techniques de radiologie   Marc LEMORT (Coordinator) ② 2 credits [lecture: 12h, practical work: 12h] 🛗 second term 🔎 French
MEDI-H506	Magnetic Resonance Imaging and Biomedical Nanotechnology   Gilles BRUYLANTS (Coordinator) and Thierry METENS

or

or

## Option Biomedical image analysis and informatics

Choisir un minimum de 20 crédits dans le module 596

### Module 596 - Biomedical image analysis and informatics

② 5 credits [lecture: 48h, practical work: 12h] 🛗 second term ♀ English

#### A total of 20 credits chosen from the following

BINF-F401 (optional)	Image: Computational Methods for Functional Genomics       Vincent DETOURS (Coordinator)         Image: Structure: 36h, practical work: 24h]       Image: Structure Structu
INFO-H501 (optional)	Pattern recognition and image analysis       Olivier DEBEIR (Coordinator) and Christine DECAESTECKER         ③ 5 credits [lecture: 36h, practical work: 24h]
INFO-H502 (optional)	Virtual Reality       Gauthier LAFRUIT (Coordinator)         ③ 5 credits [lecture: 24h, practical work: 24h]
INFO-H503 (optional)	GPU computing   Gauthier LAFRUIT (Coordinator) and Jan LEMEIRE ③ 5 credits [lecture: 24h, practical work: 24h, project: 24h]
MEDI-H506 (optional)	Magnetic Resonance Imaging and Biomedical Nanotechnology       Gilles BRUYLANTS (Coordinator) and Thierry METENS         Imaging Structure: 48h, practical work: 12h]       Imaging second term       English



## **Option Medical radiophysics**

#### Choose a minimum of 25 credits

A total of 25 credits chosen from the following

INFO-H501	Pattern recognition and image analysis   Olivier DEBEIR (Coordinator) and Christine DECAESTECKER
(optional)	③ 5 credits [lecture: 36h, practical work: 24h] 🛗 second term 🔎 English
MEDI-H401 (optional)	Radioprotection médicale, y compris les techniques de radiologie   Marc LEMORT (Coordinator)         ③ 2 credits [lecture: 12h, practical work: 12h] <sup>(1)</sup> second term <sup>(2)</sup> French
MEDI-H502	Eléments de physique et chimie nucléaire   Nicolas PAULY (Coordinator)
(optional)	③ 5 credits [lecture: 24h, tutorial classes: 12h, practical work: 24h]
PHYS-H407 (optional)	Nuclear measurement techniques       Nicolas PAULY (Coordinator)         ③ 5 credits [lecture: 24h, practical work: 36h] <sup>(1)</sup> second term <sup>(2)</sup> English
PHYS-H409 (optional)	Physical principles of magnetic resonance imaging       Thierry METENS (Coordinator)         ③ 3 credits [lecture: 22h, tutorial classes: 2h, practical work: 6h] <sup>(1)</sup> second term           Coordinator)
PHYS-H501	Introduction to medical physics   Nicolas PAULY (Coordinator) and Stéphane SIMON
(optional)	③ 3 credits [lecture: 12h, tutorial classes: 12h, practical work: 12h]
PHYS-H516	Physical aspects of radiation protection Stéphane SIMON (Coordinator) and Nicolas PAULY
(optional)	③ 3 credits [lecture: 12h, tutorial classes: 12h, practical work: 12h] — first term — French
PHYS-H518	Radiobiology, biological and genetic effects of radiations   Nicolas PAULY (Coordinator) and Sébastien Penninckx
(optional)	③ 1 credit [lecture: 12h] 👚 second term 🔎 French
PHYS-H519 (optional)	Legal and regulatory aspects of radiation protection       Thibault Vanaudenhove (Coordinator)         I credit [lecture: 12h]       Image: second term       French
PHYS-H520	Effets médicaux de l'exposition aux rayonnements ionisants   Nicolas PAULY (Coordinator) and Dirk VAN GESTEL
(optional)	① 1 credit [lecture: 12h] 👚 second term 🔎 French

## **Electives courses**

#### Choose a module

Electives courses for Option Biomechanics and instrumentation or Option Biomechanics and biomedical image analysis and informatics or Option Instrumentation and biomedical image analysis and informatics or Option Biomedical image analysis and informatics

Choose 2 to 15 credits (max 5 credits in EPB, Faculté de Médecine, Faculté des sciences de la motricité, Modules transversaux)

2 to 15 credits chosen from the following		
BIME-G5505	Interfaculty and interdisciplinary program in Healthcare Innovation Hilde STEVENS (Coordinator)	
(optional)	© 5 credits [lecture: 40h, tutorial classes: 20h] 📋 second term 📿 English	
BIME-Y500 (optional)	O 5 credits [lecture: 48h, project: 12h] <sup>(1)</sup> second term <sup>(2)</sup> English	
BIME-Y501	Clinical evaluation of medical devices Thibaut Kyun	
(optional)	② 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h]  min first term ♀ English	

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BNG-H5000 Instrumation       Introduction à la bioinformatique et à ses applications   Dimitri GILIS (Coordinator) and Fabrizio PUCCI © 5 credits [lecture: 36b, practical work: 24b]		
CHM-F4001       Rational drug design and PKPD modeling   Jean-Christophe LELOUP (Coordinator) and Martine PREVOST         © 5 credits [lecture: 36h, tutorial classes: 12h, project: 24h]       © second term       © English         EEEC-H417       Communication networks : protocols and architectures   Jean-Michel DRICOT (Coordinator)       © 5 credits [lecture: 36h, practical work: 24h]       first term       © English         EEEC-H316       Industrial Automation   Dragomir MILOJEVIC (Coordinator)       © 3 credits [lecture: 12h, practical work: 24h]       first term       © English         EVEN-14110       Compartiments environnementaxu, production, consommation et leurs impacts sur la santé   Olivier VANDENBERG (Coordinator) and Valérie ROORYCK       © 5 credits [lecture: 12h, practical work: 48h]       @ second term       © Finglish         EVEN-1411       Compartiments (ROORYCK       © 5 credits [lecture: 24h, tutorial classes: 12h]       @ second term       © English         INFD-H503       Geo-Spatial and web technologies   Mahmoud SARR (Coordinator)       © scredits [lecture: 24h, practical work: 24h]       @ second term       © English         INFD-H503       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI       © 5 credits [lecture: 24h, practical work: 24h]       @ second term       © English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator) ino' to redits [lecture: 24h, tutorial classes	BING-H5000 (optional)	Introduction à la bioinformatique et à ses applications   Dimitri GILIS (Coordinator) and Fabrizio PUCCI I first term Prench
ELEC-H417       Communication networks : protocols and architectures   Jean-Michel DRICOT (Coordinator)         EVEC-H417       S credits [lecture: 36h, practical work: 24h]       Inst term       English         ELEC-H516       Industrial Automation   Dragomir MILOJEVIC (Coordinator)       S credits [lecture: 12h, practical work: 24h]       English         ENVI-L4110       Compartiments environnementaux, production, consommation et leurs impacts sur la santé   Olivier VANDENBERG (Coordinator) and Valérie ROORYCK       S credits [lecture: 12h, practical work: 48h]       second term       French         GES1-S423       IP Management and Technology Transfer (Chaire Solvay)   Bruno VAN POTTELSBERGHE (Coordinator) and Frédéric DE CONINCK       S credits [lecture: 24h, tutorial classes: 12h]       second term       English         INFO-H5D9       Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator)       S credits [lecture: 24h, tutorial classes: 12h]       second term       English         INFO-H5D5       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI       S credits [lecture: 24h, tutorial classes: 12h, project: 24h]       second term       English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       S credits [lecture: 24h, tutorial classes: 24h]       second term       English         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       S credits [lecture:	CHIM-F4001 (optional)	Rational drug design and PKPD modeling   Jean-Christophe LELOUP (Coordinator) and Martine PREVOST ② 5 credits [lecture: 36h, tutorial classes: 12h, project: 24h] 🛗 second term 🕟 English
ELEC-H516       Industrial Automation   Dragomir MILOJEVIC (Coordinator)         biptoreal       © 3 credits [lecture: 12h, practical work: 24h]       first term       English         ENVI-L4110       Compartiments environnementaux, production, consommation et leurs impacts sur la santé   Olivier VANDENBERG (Coordinator) and Valérie ROORYCK       © 5 credits [lecture: 12h, practical work: 48H]       escond term       French         CEST-S423       IP Management and Technology Transfer (Chaire Solvay)   Bruno VAN POTTELSBERGHE (Coordinator) and Frédéric DE CONINCK       © 5 credits [lecture: 24h, tutorial classes: 12h]       escond term       English         INFO-H509       Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator)       © 5 credits [lecture: 24h, practical work: 12h]       escond term       English         INFO-H515       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI       © 5 credits [lecture: 24h, practical work: 24h]       escond term       English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       © 4 credits [lecture: 24h, practical work: 24h]       escond term       English         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       English       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       © 5 credits [lecture: 24h, tutorial classes: 24h]       first term       English	ELEC-H417 (optional)	Communication networks : protocols and architectures   Jean-Michel DRICOT (Coordinator) ② 5 credits [lecture: 36h, practical work: 24h] 🛗 first term 📿 English
ENVI-L4110       Compartiments environnementaux, production, consommation et leurs impacts sur la santê   Olivier VANDENBERG (Coordinator) and Valérie ROORYCK         © 5 credits [lecture: 12h, practical work: 48h]       © second term       Prench         GEST-5423       IP Management and Technology Transfer (Chaire Solvay)   Bruno VAN POTTELSBERGHE (Coordinator) and Frédéric DE CONINCK         © 5 credits [lecture: 24h, tutorial classes: 12h]       © second term       © English         INFO-H509       Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator)       © S credits [lecture: 24h, practical work: 12h]       © second term       © English         INFO-H515       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMP        © 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h]       © second term       English         NATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       © 4 credits [lecture: 24h, practical work: 24h]       © second term       English         NECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       © first term       English         MECA-H411       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens       © 5 credits [lecture: 36h, tutorial classes: 24h]       first term       English         STAG-H500       Internship (3 months)   Frédéric ROBERT (Coordinator)       © 10 credits [work: placement: 300h]	ELEC-H516 (optional)	Industrial Automation   Dragomir MILOJEVIC (Coordinator)         ③ 3 credits [lecture: 12h, practical work: 24h]
GEST-5423       IP Management and Technology Transfer (Chaire Solvay) Bruno VAN POTTELSBERGHE (Coordinator) and Frédéric DE CONINCK         © 5 credits [lecture: 24h, tutorial classes: 12h]       is second term       English         INFO-H509       Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator)       is credits [lecture: 24h, practical work: 12h]       is second term       English         INFO-H509       Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator)       is credits [lecture: 24h, practical work: 12h]       is second term       English         INFO-H515       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI       is second term       English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       is second term       English         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       is second term       English         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       is second term       English         MECA-H409       Design methodology   Alain DERAEMAEKER (Coordinator) and Wout Weijtjens       is second term       English         MECA-H4011       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens       is second term       English         STAG-H500       Internship (3 months)   Frédéric ROBERT (Coordinator)       is	ENVI-L4110 (optional)	Compartiments environnementaux, production, consommation et leurs impacts sur la santé   Olivier VANDENBERG (Coordinator) and Valérie ROORYCK
GEST-5423       IP Management and Technology Transfer (Chaire Solvay)   Bruno VAN POTTELSBERGHE (Coordinator) and Frédéric DE CONINCK         © 5 credits [lecture: 24h, tutorial classes: 12h]       is second term       English         INFO-H509       Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator)       • 5 credits [lecture: 24h, practical work: 12h]       is second term       English         INFO-H519       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI       • 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h]       is second term       English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       • 4 credits [lecture: 24h, practical work: 24h]       is second term       English         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       • 4 credits [lecture: 24h, practical work: 24h]       is second term       English         MECA-H411       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator)       • 5 credits [lecture: 24h, tutorial classes: 24h] prist term       English         MECA-H411       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens       • 5 credits [lecture: 36h, tutorial classes: 24h]       first term       English         STAG-H500       Internship (3 months)   Frédéric ROBERT (Coordinator)       • 10 credits [work placement: 300h]       first term       English		O 5 credits [lecture: 12h, practical work: 48h] □ second term > French
O 5 credits [lecture: 24h, tutorial classes: 12h]       B second term       English         INFO-H509       Geo-Spatial and web technologies [ Mahmoud SAKR (Coordinator) O 5 credits [lecture: 24h, practical work: 12h]       B second term       English         INFO-H515       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI         O 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h]       B second term       English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       O 4 credits [lecture: 24h, practical work: 24h]         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       O 5 credits [lecture: 24h, tutorial classes: 24h, personal assignments: 12h]       first term       English         MECA-H4111       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator)       O 5 credits [lecture: 36h, tutorial classes: 24h]       first term       English         MECA-H500       Internship (3 months)   Frédéric ROBERT (Coordinator)       O 10 credits [work placement: 300h]       first term       English         Staptoreal       0 10 credits [work placement: 300h]       first term       English	GEST-S423 (optional)	IP Management and Technology Transfer (Chaire Solvay) Bruno VAN POTTELSBERGHE (Coordinator) and Frédéric DE CONINCK
INFO-H509       Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator)         O 5 credits [lecture: 24h, practical work: 12h]       is second term       English         INFO-H515       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI         O 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h]       is second term       English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       4 credits [lecture: 24h, practical work: 24h]         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       6 5 credits [lecture: 24h, tutorial classes: 24h, personal assignments: 12h]       first term       English         MECA-H411       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens       6 5 credits [lecture: 36h, tutorial classes: 24h]       first term       English         STAG-H500       Internship (3 months)   Frédéric ROBERT (Coordinator)       6 10 credits [work placement: 300h]       first term       French         Elective courses for Option Medical Radiophysics       French       Elective courses for Option Medical Radiophysics		🕐 5 credits [lecture: 24h, tutorial classes: 12h] 🛛 🛗 second term 🔗 English
INFO-H515       Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI         © 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h]       escond term       English         MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)       o 4 credits [lecture: 24h, practical work: 24h]       escond term       English         MECA-H409       Design methodology   Alain DELCHAMBRE (Coordinator)       o 5 credits [lecture: 24h, tutorial classes: 24h, personal assignments: 12h]       first term       English         MECA-H411       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens       o 5 credits [lecture: 36h, tutorial classes: 24h]       first term       English         STAG-H500       Internship (3 months)   Frédéric ROBERT (Coordinator)       o 10 credits [work placement: 300h]       first term       French         Elective courses for Option Medical Radiophysics       Elective courses for Option Medical Radiophysics       French	INFO-H509 (optional)	Geo-Spatial and web technologies   Mahmoud SAKR (Coordinator) ② 5 credits [lecture: 24h, practical work: 12h] 🛗 second term 🔎 English
<ul> <li>S credits [lecture: 24h, tutorial classes: 12h, project: 24h]  second term  English</li> <li>MATH-H503</li> <li>Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)         <ul> <li>4 credits [lecture: 24h, practical work: 24h]  second term  English</li> </ul> </li> <li>MECA-H409</li> <li>Design methodology   Alain DELCHAMBRE (Coordinator)         <ul> <li>S credits [lecture: 24h, tutorial classes: 24h, personal assignments: 12h]  first term  English</li> </ul> </li> <li>MECA-H411         <ul> <li>Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens             <ul> <li>S credits [lecture: 36h, tutorial classes: 24h]  first term  English</li> </ul> </li> <li>STAG-H500         <ul> <li>Internship (3 months)   Frédéric ROBERT (Coordinator)             <ul> <li>In credits [work placement: 300h]  first term  French</li> <li>Elective courses for Option Medical Radiophysics</li> </ul> </li> </ul></li></ul></li></ul>	INFO-H515 (optional)	Big Data: Distributed Data Management and Scalable Analytics   Dimitrios SACHARIDIS (Coordinator) and Gianluca BONTEMPI
MATH-H503       Model-Based and Data-Driven Fault Detection and Isolation   Michel KINNAERT (Coordinator)         (optional)		🕐 5 credits [lecture: 24h, tutorial classes: 12h, project: 24h] 🛛 🛗 second term 🛛 $\wp$ English
MECA-H409 (optional)       Design methodology   Alain DELCHAMBRE (Coordinator) ⊙ 5 credits [lecture: 24h, tutorial classes: 24h, personal assignments: 12h]          ☐ first term        ○ English          MECA-H411 (optional)       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens ⊙ 5 credits [lecture: 36h, tutorial classes: 24h]          ☐ first term        ○ English          STAG-H500 (optional)       Internship (3 months)   Frédéric ROBERT (Coordinator) ⊙ 10 credits [work placement: 300h]          ☐ first term        ○ French          Elective courses for Option Medical Radiophysics	MATH-H503 (optional)	Model-Based and Data-Driven Fault Detection and Isolation       Michel KINNAERT (Coordinator)         ③ 4 credits [lecture: 24h, practical work: 24h]
MECA-H411       Mechanical Vibrations   Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens         (optional)       5 credits [lecture: 36h, tutorial classes: 24h]         STAG-H500       Internship (3 months)   Frédéric ROBERT (Coordinator)         (optional)       0 10 credits [work placement: 300h]         Elective courses for Option Medical Radiophysics	MECA-H409 (optional)	Design methodology       Alain DELCHAMBRE (Coordinator)         ③ 5 credits [lecture: 24h, tutorial classes: 24h, personal assignments: 12h]
STAG-H500 (optional)       Internship (3 months)       Frédéric ROBERT (Coordinator)         ③ 10 credits [work placement: 300h] <ul> <li>first term</li> <li>French</li> </ul> Elective courses for Option Medical Radiophysics	MECA-H411 (optional)	Mechanical Vibrations       Arnaud DERAEMAEKER (Coordinator) and Wout Weijtjens         ③ 5 credits [lecture: 36h, tutorial classes: 24h]
Elective courses for Option Medical Radiophysics	STAG-H500 (optional)	Internship (3 months)   Frédéric ROBERT (Coordinator) ② 10 credits [work placement: 300h]
Elective courses for Option Medical Radiophysics	L	
	г	Elective courses for Option Medical Radiophysics

A total of ten credits chosen from the following	
BIME-G5505 (optional)	Interfaculty and interdisciplinary program in Healthcare Innovation   Hilde STEVENS (Coordinator) ② 5 credits [lecture: 40h, tutorial classes: 20h] 🗎 second term 👂 English
ENVI-L4110 (optional)	Compartiments environnementaux, production, consommation et leurs impacts sur la santé   Olivier VANDENBERG (Coordinator) and Valérie ROORYCK ② 5 credits [lecture: 12h, practical work: 48h] 👚 second term 🔎 French
GEST-S423 (optional)	IP Management and Technology Transfer (Chaire Solvay) Bruno VAN POTTELSBERGHE (Coordinator) and Frédéric DE CONINCK ② 5 credits [lecture: 24h, tutorial classes: 12h] 🛱 second term 🔎 English
MATH-F502 (optional)	Imagerie et problèmes inverses   Ignace LORIS (Coordinator) ② 5 credits [lecture: 24h, tutorial classes: 12h] 👚 second term 👂 French
MATH-H507 (optional)	Méthodes de Monte Carlo   Pierre-Etienne LABEAU (Coordinator)         ② 2 credits [lecture: 12h, tutorial classes: 12h]            first term
STAG-H500 (optional)	Internship (3 months)   Frédéric ROBERT (Coordinator) ② 10 credits [work placement: 300h]



## Free elective courses

Students have also the opportunity to choose courses among the courses of the 'transversal modules' of the School.

English : LANG-H500

Engineering and society : PROJ-H421 - GEST-H509 - BIME-G5505 - PHYS-F517

Sustainability : GEST-S492 - ENVI-F405 - CHIM-H504 - ENVI-F452 - ENVI-F454 - ELEC-Y514

Finance, accounting, management, marketing, logistics and quality : GEST-S101 - GEST-S318 - GEST-S421 - GEST-Y501 GEST-H501 - GEST-H502

Participation to a summer school : EDUC-H601

#### Free elective courses

#### Up to six credits chosen from the following

BIME-G5505	Interfaculty and interdisciplinary program in Healthcare Innovation   Hilde STEVENS (Coordinator)
(optional)	② 5 credits [lecture: 40h, tutorial classes: 20h] 🛗 second term 📿 English
CHIM-H504 (optional)	Engineering aspects of circular economy Prakash VENKATESAN (Coordinator) <ul> <li>5 credits [lecture: 24h, practical work: 36h]</li> <li>second term</li> <li>English</li> </ul>
DROI-C5174	Approche interdisciplinaire du droit de la propriété intellectuelle/Interdisciplinary Approach to In Julien CABAY (Coordinator)
(optional)	② 5 credits [lecture: 24h] — first term — English/French
EDUC-H601	Summer School   Johan GYSELINCK (Coordinator)
(optional)	② 5 credits [personal assignments: 5h]
ELEC-Y514	Sustainability : an interdisciplinary Approach   Cathy MACHARIS (Coordinator) and Waldo Galle
(optional)	② 6 credits [lecture: 36h, practical work: 24h] 🗂 academic year 📿 English
ENVI-F405	Climat: sciences et politiques   Frank PATTYN (Coordinator) and Louise Knops
(optional)	② 5 credits [lecture: 40h] 📋 second term 👂 French
ENVI-F452	Environmental impact analysis and management Wouter ACHTEN (Coordinator)
(optional)	② 5 credits [lecture: 24h, practical work: 12h, project: 24h]
ENVI-F454	Energie: Société et environnement Michel HUART (Coordinator) and Nadine MATTIELLI
(optional)	② 5 credits [lecture: 30h, practical work: 12h, project: 24h]
GEST-H501 (optional)	Logistics Engineering and Management       Alassane Ballé NDIAYE (Coordinator)         ② 5 credits [lecture: 12h, tutorial classes: 36h] <sup>™</sup> first term
GEST-H502	Supply Chain Performance Analytics   Alassane Ballé NDIAYE (Coordinator)
(optional)	③ 5 credits [lecture: 12h, tutorial classes: 36h, personal assignments: 12h]
GEST-H509 (optional)	🗂 unknown term
GEST-S101	Comptabilité financière   Gilles GEVERS (Coordinator) and Laurent GHEERAERT
(optional)	② 5 credits [lecture: 36h, tutorial classes: 8h] 🛗 second term 📿 French
GEST-S318	Introduction to theoretical finance   Laurent GHEERAERT (Coordinator)
(optional)	② 5 credits [lecture: 24h, tutorial classes: 24h] 🛗 second term 💭 English
GEST-S421 (optional)	O       5 credits [lecture: 24h, tutorial classes: 24h]       Image: Second term       English
GEST-S492	Energy policy, sustainability & management   Adel EL Gammal (Coordinator), Julien BLONDEAU and Michel HUART
(optional)	② 5 credits [lecture: 36h, seminars: 24h] 🛗 first term 🔎 English
GEST-Y501	Business Management and Entrepreneurship   Marc GOLDCHSTEIN (Coordinator)
(optional)	② 3 credits [lecture: 33h] 🛗 first term 🔎 English
LANG-H500 (optional)	English for professional purposes       Alexander CORNFORD (Coordinator) and Matthew LANGSLEY         ③ 5 credits [tutorial classes: 48h, personal assignments: 12h]



 PHYS-F517
 How To Make (almost) Any Experiment Using Digital Fabrication | Denis TERWAGNE (Coordinator)

 (optional)
 ③ 5 credits [lecture: 24h, practical work: 24h]

 <sup>(1)</sup> first term ♀ French

PROJ-H421 (optional) Projet polydaire: expériences didactiques innovantes pour le secondaire | Simon-Pierre GORZA (Coordinator) ② 5 credits [project: 150h] 📋 academic year 📿 French