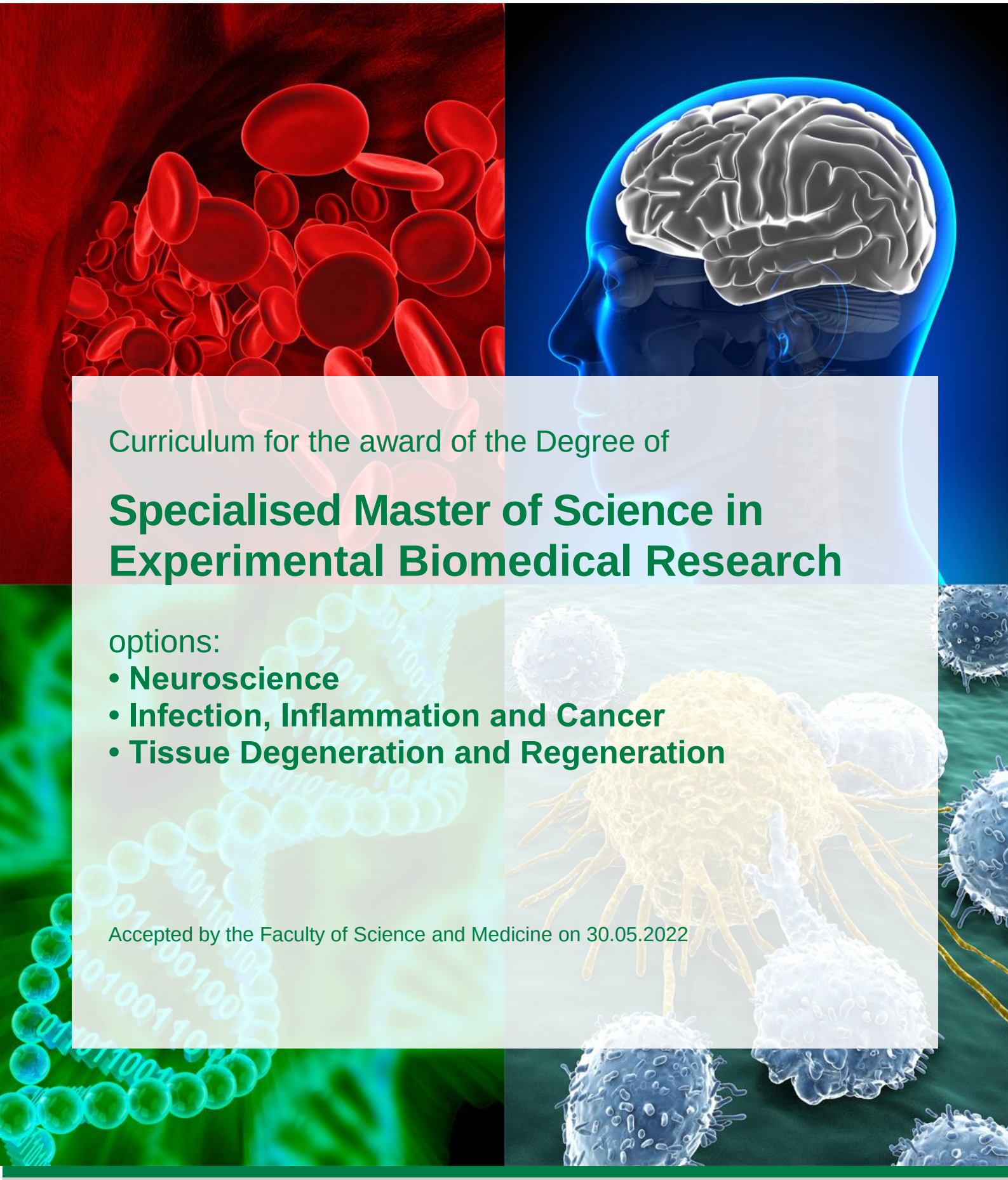
UNIVERSITÉ DE FRIBOURG
UNIVERSITÄT FREIBURG



Curriculum for the award of the Degree of

Specialised Master of Science in Experimental Biomedical Research

options:

- **Neuroscience**
- **Infection, Inflammation and Cancer**
- **Tissue Degeneration and Regeneration**

Accepted by the Faculty of Science and Medicine on 30.05.2022

TABLE OF CONTENTS

1 General remarks

This curriculum describes all regulations concerning the study of experimental biomedical research at the Master level at the University of Fribourg. It is based on the regulations of the Faculty of Science and Medicine as defined in the *Règlement pour l'obtention des Bachelor of Science et des Master of Science de la Faculté des sciences et de médecine* of 30 May 2022 (hereafter called the *Regulation* in short). In case of discrepancies of translation, the French version will be considered authoritative.

The Regulation of 30 May 2022 for the award of the Bachelor of Science and Master of Science degrees establishes a limit on the duration of Bachelor's and Master's studies, as well as of the minor study program (see articles 11, 13 and 14) (https://www3.unifr.ch/scimed/fr/rules/regulations).

1.1 Academic title and study plan

The Faculty of Science and Medicine of the University of Fribourg awards the following official academic title to students who have successfully completed their studies:

Specialised Master of Science in Experimental Biomedical Research (sp-MSc), University of Fribourg

The programme consists of five modules:

- Compulsory common courses: 27 ECTS credits
- Elective courses: 6 ECTS credits
- Compulsory courses in one of the three options: 12 ECTS credits
- Master thesis-related activities: 15 ECTS credits
- Master thesis: 60 ECTS credits

Three options (specialisations) with specific courses are offered:

- Neuroscience
- Infection, Inflammation and Cancer
- Tissue Degeneration and Regeneration

Elective courses not listed in the study programme of these options may also be taken. In this case, the student must consult the study advisor.

The sp-**MSc study programme** in Experimental biomedical research (subsequently called sp-MSc) provides the students with advanced courses in their chosen specialisation, as well as a foundation of compulsory courses. The programme aims at preparing students for a PhD programme. At the same time, the programme provides students with skills needed for a successful career in health-related industry and administration.

Candidates with a Bachelor degree in biology, biochemistry, biomedical sciences or medicine from the University of Fribourg or from another Swiss university, can apply to the sp-MSc (as outlined in Section 2.5 below). Applicants in possession of a BSc degree from other countries or in a different but related subject can also be admitted into the programme based on a decision of the Faculty of Science and Medicine. The admission decision is made individually for each case. Provisional admission can be granted and depends on the fulfilment of additional requirements set by the Faculty (see Section 2.5 below).

1.2 Course structure

The course work leading to the sp-MSc degree is subdivided into "**UE**" (= teaching units, from "unité d'enseignement" or "Unterrichtseinheit"), consisting of formal lectures, exercise classes, practical courses, seminars, and specialised projects. To each UE, a number of **ECTS credits** (European Credit Transfer System) is assigned.

The sp-MSc degree requires a minimum of 120 ECTS credits over four semesters. The programme is subdivided into two parts (or *validation packages*):

- formal lectures, practical courses, projects, seminars (60 ECTS credits)
- a Master project that terminates with the Master thesis (60 ECTS credits).

The purpose of the different UE types is as follows:

- **Lectures** give a formal introduction to the scientific methods in basic and experimental biomedical research and encourage advanced scientific thinking. They help acquiring the basic knowledge and understanding of the fundamental concepts in specific disciplines.
- **Laboratory work**, be it experimental or theoretical, is the basis of scientific research. It provides a supervised environment for the hands-on realization of biological and medical measurements. It is during this work that the student will encounter and learn many of the techniques and instruments used in biological and medical research.
- **Seminar presentations** are used to expand the student's knowledge in specialised domains, often neglected in the formal courses, as well as to begin the development of oral presentation skills for communication of scientific results.
- **Student projects** are a first step towards applying the skills learned in the lectures and exercise classes to address and solve appropriate research questions.
- The preparation of the **Master thesis**, under the supervision of an experienced researcher, is the actual starting point of scientific research.

1.3 Acquired skills

The aim of the studies leading to the award of a specialised MSc in Experimental Biomedical Research is to deepen knowledge and techniques, and to perfect competence in the chosen field and, at the same time, develop skills in scientific English and scientific writing. Thus, at the end of the study programme, a student will have shown that he/she can apply their knowledge to accomplish a research project and will have learned how to work independently, how to integrate into an interdisciplinary research team and how to present and discuss the obtained results. The successful completion of the degree requires creative and self-critical talents as well as the ability to both communicate ideas and work in English.

1.4 Course assessment (UE) and accreditation of ECTS credits

Acquisition of ECTS credits occurs via three steps: assessment of individual UE, grouping of UE into a validation package, and awarding the respective ECTS credits for the completed package.

Assessment of lectures is made by an oral and/or written exam, whose type and duration are specified in an appendix to this curriculum. Exams occur during the official exam sessions in winter, summer, or autumn, and are subject to a fee. Students register for each exam via the students' web portal MyUniFR (https://my.unifr.ch), within the stipulated deadlines according to the on-line procedure and using their University-provided account and password. The marks range from 6 (highest mark) to 1 (lowest mark). An exam marked below 4 can be repeated, but only once, and at earliest during the next exam session.

A **Validation package** comprises multiple, separately assessed, UE. Article 24 and 27 of the Regulation determines the number of these packages whereas this curriculum determines their content.

The conditions for validation of ECTS credits are described in Art. 25 of the Regulation.

After the validation, upon request, the Dean's office will issue Transcripts of records in which exam results and awarded credits are acknowledged (Art. 28 and 30 of the Regulation), provided the exam fee has been paid.

1.5 Teaching languages

MSc courses are generally taught in English, although selected courses may be conducted in the German or French language. Written work (project reports, MSc thesis, etc.) will preferably be in English. Texts in French or in German are also accepted.

1.6 Ethics and science

Ethical principles are an integral part of a scientific education. Accepted international conventions must be respected during research and while documenting all scientific work whether it be a project, a lecture, a thesis, or a report. In particular, every external source of information (articles, lectures, web pages, etc.) must be correctly cited.

1.7 Regulations and additional Information

Detailed information about studying Experimental Biomedical Research can be found in the documents referenced on the web page http://www.unifr.ch/scimed/plans which are also available on the section website (https://www.unifr.ch/med/fr/) as well as from the Office of the Medicine Section.

2 Specialised Master of Science (sp-MSc)

[Version 2022, validation packages:
Option N: PV-SME.000054, PV-SME.000055
Option IIC: PV-SME.000056, PV-SME.000057
Option RCM: PV-SME.000058, PV-SME.000059]

The sp-MSc programme in Experimental Biomedical Research requires 120 ECTS credits to be completed, and is expected to take 24 months. The first year consists primarily of courses, seminars, and the first part of the Master work, designed to strengthen and complete the student's existing biomedical knowledge, as well as the proper scientific conduct and skills to communicate research. As members of a research team, the Master students take part in various activities such as research group meetings, seminars, and literature study/journal clubs. Students are expected to participate in those activities throughout the duration of the study. The credits for these activities amount to 15 ECTS. The sp-MSc degree courses are completed by a research project of 60 ECTS in total, which includes the writing of a Master thesis.

2.1 MSc course units

In the first year of the study programme, sp-MSc students follow all compulsory course units (27 ECTS), as well as elective course units (6 ECTS) and compulsory course units (12 ECTS) in their chosen specialisation. The study programme is complemented by thesis-related activities in the chosen specialisation (15 ECTS) and the MSc thesis (60 ECTS).

***Compulsory** Course Units*

Code	Title of UE	Semester	tot. h.	ECTS
SME.07010	Basic knowledge upgrading	AS	6-9	1
SME.07100	Models for human diseases	AS	28	3
SME.07200	Infection, inflammation and cancer	AS	28	3
SME.07300	Central nervous system regeneration and repair	AS	28	3
SME.07400	Microscopy in life sciences	AS	28	3
SME.07501	Scientific communication	AS	28	3
SME.07502	Advanced scientific writing	SS	28	3
SME.07700	Data analysis and statistics with the R programming language	AS	28	3
SME.07701	Introduction to modern instrumentation	SS	28	3
SBL.00427	Visual communication of data	SS	8	1
SBL.10004	Ethics in stem cell research	SS	8	1
Total				**27**
SME.07800	Master thesis			**60**

***Elective** Course Units*

Code	Title of UE	Semester	tot. h.	ECTS
SBL.00420[a#]	Career profiling in life sciences	SS	8	1
I02.00106	*B2-C2 English for Master Students of Science I*	AS	-	3
I02.00107	*B2-C2 English for Master Students of Science II*	SS	-	3
SBL.00115[#]	The RNA world	AS	12	1.5
SBL.00419[#]	Advanced imaging	SS	8	1
SBL.00451[b#]	Introduction to mass spectrometry and proteomics	AS	8	1
SBL.00452[b#]	Advanced quantitative proteomics	SS	12	1
SBL.00119[c#]	Molecular genetics of model organism development	AS	28	3
SBL.10001[c#]	Modelling human diseases in experimental genetic systems	SS	20	2
SBL.10002[c#]	From bench to bedside	SS	5	0.5
SBL.00428 [a#]	Optogenetics and photopharmacology	SS	8	1
SCH.05123	Innovation and Entrepreneurship	AS	48	4.5
Minimum ECTS credits required from elective Course Units				**6**

[#] Offered by the Dept. of Biology.

[a] Offered every two years. See table below.

[b] SBL.00451 and SBL.00452 must be taken together. Up to 5 students accepted per session; contact Dept. of Biology.

[c] SBL.00119, SBL.10001 and SBL.10002 must be taken together.

*Compulsory course Units in the **Neuroscience** option*

Code	Title of UE	Semester	tot. h.	ECTS
SME.07301	Behavioural methods in neuroscience	AS	28	3
SME.07305	From neurons to culture and back	AS	28	3
L25.00721*	Sleep and visual neuroscience [L071.0821]	AS	28	3
L25.00644*	Introduction to Matlab I [L071.0743]	SS	14	3
Total				**12**

* Offered by the Dept. of Psychology, Faculty of Humanities
Subject to change. See the up to date list under moodle.

*Thesis-related activities in the **Neuroscience** option*

Code	Title of UE	Semester	tot. h.	ECTS
SME.07002	Fribourg day of cognition	AS	8	0.5
SME.06001[§]	Neurobiology (seminar)	AS	5	0.5
SME.07001[§]	Neurobiology (seminar)	SS	5	0.5
SME.07306	Frontiers in neuroscience BENEFRI (workshop) NEW	block	6	0.5
SME.07307	Neuroscience journal club NEW [2 semesters x 18h]	AS/SS	36	4
SME.07609	Research group meetings in Neuroscience NEW [3 semesters x 18h]	AS/SS	54	4.5
SME.07602	Project design in Neuroscience	SS	42	4.5
Total				**15**

[§] At least 2/3 of the seminar sessions must be taken in the option chosen. 1/3 of the seminars can be taken in the other options.

*Compulsory Course Units in the **Infection, Inflammation and Cancer** option*

Code	Title of UE	Semester	tot. h.	ECTS
SME.07201	Cellular immunology: theory and practice	AS	28	3
SME.07215	Hot topics in Cancer research, Metabolic health and Regenerative biomedicine	SS	28	3
SME.07203	Principles and methods in investigating and treating age-associated heart and vascular diseases	SS	28	3
SME.07209	Concepts and approaches in metabolic phenotyping, anti-obesity targeting and hypoxia research	SS	28	3
Total				**12**

*Thesis-related activities in the **Infection, Inflammation and Cancer** option*

Code	Title of UE	Semester	tot. h.	ECTS
SME.07210§	Section of medicine research (seminar)	AS	6	0.5
SME.07211§	Section of medicine research (seminar)	SS	6	0.5
SME.07213	Joint research group meetings of Dept OMI (Oncology, Microbiology and Immunology)	AS/SS	6	0.5
SME.07212	Research Day in Medicine	SS	8	0.5
SME.07214	Cancer/inflammation research journal club [2 semesters x 18h]	AS/SS	36	4
SME.07603	Research group meetings in cancer/inflammation [3 semesters x 18h]	AS/SS	54	4.5
SME.07604	Project design in cancer/inflammation	SS	42	4.5
Total				**15**

§ At least 2/3 of the seminar sessions must be taken in the option chosen. 1/3 of the seminars can be taken in the other options.

*Compulsory Course Units in the **Tissue Degeneration and Regeneration** option*

Code	Title of UE	Semester	tot. h.	ECTS
SME.07203	Principles and methods in investigating and treating age-associated heart and vascular diseases	SS	28	3
SME.07209	Concepts and approaches in metabolic phenotyping, anti-obesity targeting and hypoxia research	SS	28	3
SME.07201	Cellular immunology: theory and practice	AS	28	3
SME.07215	Hot topics in Cancer research, Metabolic health and Regenerative biomedicine	SS	28	3
Total				**12**

*Thesis-related activities in the **Tissue Degeneration and Regeneration** option*

Code	Title of UE	Semester	tot. h.	ECTS
SME.07104[§]	Joint research group meetings of Dept EMC (Endocrinology, Metabolism and Cardiovascular System)	AS/SS	12	1
SME.07212	Research Day in Medicine	SS	8	0.5
SME.07102	Research symposium	AS or SS	8	0.5
SME.07105	Tissue Degeneration and Regeneration journal club [2 semesters x18h]	AS/SS	36	4
SME.07607	Research group meetings in Tissue Degeneration and Regeneration [3 semesters x 18h]	AS/SS	54	4.5
SME.07608	Project design in Tissue Degeneration and Regeneration	SS	42	4.5
Total				**15**

[§] At least 2/3 of the seminar sessions must be taken in the option chosen. 1/3 of the seminars can be taken in the other options.

2.2 Content of the MSc UE

2.2.1 Compulsory course units

Basic knowledge upgrading **(SME.07010)** is a refresher course based on the prerequisites to attend this study program. It is evaluated with a formative test.

The course *Models for human diseases* **(SME.07100)** will present relevant experimental models and integrative approaches for understanding physio-pathological processes of human diseases, including aging and age-related diseases such as heart failure, atherosclerosis, metabolic disorders and renal disease. Advantages and pitfalls of the models for the human diseases will be analysed. Prospective translational aspects of modifying the disease process by nutrition, therapeutics, gene/stem cell therapy, development of new drug candidates as well as choice of the best animal model for the targeted therapeutic area will be discussed.

The course *Infection, inflammation and cancer* **(SME.07200)** provides a comprehensive theoretical basis to the understanding of novel paradigms and emerging areas of research in the field of infection diseases, inflammation and cancer. The course will cover topics such as mechanisms of initiation of inflammation, perception of inflammation, the role of inflammation in cancer initiation and progression and novel pathogens and emerging resistance in infection diseases. Emphasis will be put on highlighting the significance of recently acquired knowledge in these areas and its relevance to experimental research and clinical medicine.

The course *Central nervous system regeneration and repair* **(SME.07300)** provides the conceptual background necessary for understanding major approaches for helping the brain recover from neural pathologies. The importance of behavioural characterization, functional measurements as well as therapeutic interventions such as psychopharmacology or electrical brain stimulation is illustrated by relevant examples drawn from clinical and basic science.

The course *Data analysis and statistics with the R programming language* **(SME.07700)** consists of two parts. The first part is an introduction to the R programming language. The second part of the course focuses on experimental design and statistical analysis, addressing the underlying concepts and presenting the main parametric and non-parametric tests used in inferential statistics.

The course *Microscopy in life sciences* **(SME.07400)** provides a theoretical introduction to various forms of microscopy, including light-, fluorescence- and 2-photon microscopy. Key concepts as well as practical issues for productive use of microscopy instruments will be covered. The course will include some hands-on sessions with the various instruments.

The course *Scientific communication* **(SME.07501)** provides a review of the principles and practice of the various forms of scientific communication, which is an integral part of research activity. Its objective is to learn how to communicate scientific results accurately, ending by a mini-symposium with presentations made by the students.

The course *Advanced scientific writing* **(SME.07502)** encompasses literature research, reading, writing, reviewing, editing and publishing. It engages students in a real-world exercise of scientific writing and publishing. The students will gain experience in scientific writing through an individual essay (scientific review article or book chapter)**.** This will increase the students' skills in word processing and reference management systems. The students will participate in critical evaluation of scientific writing by assessing peer-written work**,** explore relevant web sites and become familiar with electronic publishing.

The goal of the course *Introduction to modern instrumentation* **(SME.07701)** is to provide knowledges on the correct use of various methodologies that are implemented in research laboratories. This course will include theoretical and/or practical sessions on various technics, from basic useful laboratory protocols (such as molecular biology, cell culture) to more advanced (such as FACS, sequencing, mouse models), as well as some reflection about the implementation of these different technologies in research projects.

The goal of the course *Visual communication of data* **(SBL.00427)** is to provide students with the theoretical background and practical skills needed to design and create efficient graphics that fairly present quantitative data. The course content includes an overview of classical and less classical graphic types available, guidelines on how to choose the best representation based on the type of data, tricks to emphasize specific messages without inducing bias, as well as major pitfalls to avoid. Practical exercises are carried out using Excel and other simple software.

The course *Ethics in stem cell research* **(SBL.10004)** provides an overview of this wide-ranging and fast-moving field of biomedical sciences. We will address ethical implications and policy issues that are the most significant for this research domain, including controversy surrounding human embryonic stem cells, human-animal chimeras, and gametes. We will discuss the importance of information disclosure, the risk for overpromising and the therapeutic misconception of stem cells.

2.2.2 Elective course units

Career Profiling in life sciences **(SBL.00420):** After having completed their Master degree, students start applying for jobs. In this interactive course, we present the curricula of several people who are now active in the professional world. We chose different paths, from academia to industry and even less related fields. From this course you will also learn how to write a CV, how to write an application, and how to get prepared for a job interview. 15-minute interviews will be held in front of the other participants or in private. We also provide information on where to look for jobs in Switzerland.

English language courses I **(no code**): This elective course aims to help Master's students in scientific disciplines develop the English language skills relevant to their studies and future careers. The emphasis will be placed on oral presentation skills, academic writing, strategies for reading comprehension and analysis of texts, and academic listening skills. Target level is B1-C1.

English language courses II **(no code)**: This elective course is a follow-up to *English language courses I*. Target level is B2-C2.

More info: https://www.unifr.ch/centredelangues/fr/cours/semestriels/anglais/

The RNA world **(SBL.00115)**: The flow of genetic information goes from DNA to RNA, and from RNA to proteins. Then how could the first proteins be made if they are needed for transcription and translation? The hypothesis of the RNA world suggests that catalytic RNAs (ribozymes) may have preceded proteins. This lecture will briefly describe the origins of life and emphasize the importance of ribozymes, their mode of action and their roles in today's world. Other themes include the discovery and mechanism of RNA interference, the importance of small and long non-coding RNAs, RNA-based technologies including RNA vaccines, the evolution of RNA-based adaptive CRISPR immunity.

Fluorescence light microscopy is a core technique to visualize biological processes in fixed and living tissue. With new development in microscope design and image acquisition progress was also made in digital image analysis. The aim of the course *Advanced imaging* **(SBL.00419*)*** is to give the students a theoretical background in digital image analysis and to train students to use state of the art software tools. In a first module the students obtain theoretical knowledge about principles of digital image analysis and learn about ethical aspect in image manipulation. In a second module, students are taught in workshops to use image analysis opensource software ImageJ/Fiji and commercial software Bitplane Imaris and Huygens Deconvolution. In self-directed teaching tutorials student acquire basic image analysis skills (File formats, Metadata, Contrast adjustment, Background correction, Filtering). In workshops advanced techniques are learned such as image segmentation, 3D rendering, deconvolution, and co-localization. An introduction in batch processing and macro language will complete the session. The course will give practical guidelines that will help students with imaging projects in their line of research.

The courses *Introduction to mass spectrometry and proteomics* **(SBL.00451)** and *Advanced quantitative proteomics* **(SBL.00452)** are each two days block courses at the end of respective semesters. The courses teach theoretical and practical principles of mass spectrometry (MS)-based proteomics. The first course SBL.00451 introduces principals of MS analysis of peptides and proteins. Current mass analysers and underlying physical principals are introduced in lectures. Hands-on analyses of mass spectra are performed in a practical course. The second course SBL.00452 introduces quantitative MS-based proteomics principles in lectures. In a practical course proteomics experiments are performed and data is analysed by current bioinformatics approaches. After both courses, participants will be able to design and perform MS-based proteomics experiments and to analyse respective data. SBL.00451 is a prerequisite to take part in SBL.00452.
The course *Molecular genetics of model organism development* **(SBL.00119)** is an introduction into some of the most popular model systems used for the study of development. These include *Xenopus*, Mouse, *C. elegans*, *Drosophila* and Zebrafish. The value of different technical approaches will be discussed. Further emphasis will be on presenting key experiments and the most recent findings for each system. Topics may vary from year to year but are likely to include transcriptional, translational, post-translational and epigenetic control of gene expression. Recommended literature before attending this course: Scott Gilbert, *Developmental Biology*; Lewis Wolpert et al., *Principles of Development*.

Modelling human diseases in experimental genetic systems **(SBL.10001)**: Model organisms have long served for research on fundamental aspects of basic biology. More recently, they have also proven helpful in modeling human diseases, in the identification of drug targets, and in the evaluation of potential therapeutic agents. In this context, this course provides an overview on the most commonly used model organisms (ranging from simple eukaryotes such us budding yeast to more complex ones including nematodes, flies, zebrafish, and mice) and model systems (such as human cell cultures and organoids). We will discuss the specific advantages and limitation of each of these organisms and systems for modeling human diseases including neurodegenerative, cardiovascular, respiratory, muscular, skin, and hyperproliferative diseases including cancer. In addition, we will also delineate how these model systems can be exploited to identify molecular mechanisms and therapeutic strategies for the treatment of diverse human diseases. This lecture requires knowledge of the main genetic organisms (SBL.00119).

The course *From bench to bedside* **(SBL.10002)** presents a broad overview of the many steps separating fundamental biomedical discoveries from therapeutic applications. Covered aspects include drug development, clinical trials, drug repurposing, as well as the use of biomarkers in the emerging field of precision medicine.

Optogenetics and photopharmacology **(SBL.00428)** are two modern, fast-developing fields that use light-responsive molecules as tools for scientific research and hold promises for medical interventions. The lecture course will present ‘sensors’ used to monitor specific molecular events, as well as light-controlled molecules used to manipulate the activity of specific cells within a cellular network or the activity of specific signalling pathways within a cell. Richly illustrated with examples, the course covers the principles of these approaches, their main advantages and limitations, as well as current challenges for their application in translational medicine.

The course *Innovation and Entrepreneurship* **(SCH.05123)** provides the students with the specific skills which are critical to the success of a start-up. The course includes the elaboration and development of personal projects, going from the idea to a viable business project.

2.2.3 Courses of the *Neuroscience* option

The description of the courses offered by the Department of Psychology, Faculty of Humanities will be provided to students at the beginning of the semester via the Moodle platform.

The course *From neurons to culture and back* **(SME.07305)** is a glimpse into the evolution of cognitive processes like reading and writing, their neurophysiological principles, how they have shaped, and been shaped by human culture, and what happens when they default.

The course *Behavioural methods in neuroscience (***SME.07301)** is an introduction to laboratory methods used for behavioural and associated functional studies in humans and animals. It focuses on measurement, analysis and interpretation of behavioural parameters such as behavioural choice or reaction time, as well as functional parameters such as electroencephalographic recordings. The course is conducted in 7 modules of four hours each, and takes place in specialised laboratories.

The *BENEFRI workshop "Frontiers in neurosciences"* **(SME.07306)** is intended to make students familiar with current frontiers in neurobiological research. The course is given by national and international experts working in very diverse fields of neuroscience. Previous block courses included topics such as brain mapping, hypothalamus, motor systems, neurogenetic model systems, neuroinformatics, olfaction, sensory systems, synaptic function, and visual cortex.

The *Fribourg day of cognition* **(SME.07002)** consists of research presentations related to ongoing projects conducted in the area of behavioural, cognitive and developmental neurosciences at the University of Fribourg. Participants are asked to select a presentation and write a short summary of about 2 pages consisting of introduction, hypotheses to be tested, results and significance.

The *Neurobiology* seminars (**SME.06001 + SME.07001)** is a series of lunchtime lectures by experts in the field of neuroscience, who present recent and ongoing research and inform participants on cutting edge developments in the area of specialisation. Topics cover all areas of neuroscience including molecular, systems, behavioural and clinical neuroscience.

In the *Neuroscience journal club* **(SME.07307)** researchers and students report and debate recently published articles. *Research group meetings* **(SME.07609)** allow members of a research group to present and discuss their ongoing work. *Project design in neuroscience* **(SME.07602)** allows the students to carry out a short-term experimental and theoretical project in a research group. They can become familiar with investigation methods, learn how to collaborate efficiently with other group members and contribute actively to research. On successful accomplishment of the project they will be able to independently deal with new topics and will make the transition towards Masters level research with confidence.

During the *Master thesis* (**SME.07800)** the student familiarizes herself/himself with modern techniques and executes a research project under the guidance of a group leader within a Neuroscience research group of the Section of Medicine. This work requires designing and carrying out a research strategy, keeping a clear lab journal and data analysis. The Master thesis also includes a report written like a scientific article (summary, introduction, methods, results, discussion, references).

2.2.4 Courses of the *Infection, Inflammation and Cancer* option

The course *Cellular immunology: theory and practice* **(SME.07201)** is a balanced combination between theory and laboratory-based practical activities. The students will elaborate themselves the basic principles of immune cell types, cell characterization, cell activation and function. In parallel, laboratory protocols corresponding to the theoretical principals will be applied under the

instruction and supervision of experienced researchers. There will be emphasis on experimental design, leading to performing corresponding experiments by the students. The students will collect individual results for each experiment, to be used for statistical analysis and discussion.

The course *Hot topics in Cancer research, Metabolic health and Regenerative biomedicine* **(SME.07215)**, comprises a selection of current topics at the forefront of biomedical research presented by experts in each field. Topics vary each year and usually include, among others, cancer immunotherapy, biomarkers in cancer, vaccines, oxidative stress, tissue fibrosis, regeneration and nanomedicine. The course consists of overview lectures, scientific workshops, and demonstrations in the lab. Students will gain insights into some of the hottest and rapidly evolving research topics in the field as well as experience in critical discussion of emerging scientific questions.

The course *Principles and methods* **(SME.07203)** *in investigating and treating age-associated heart and vascular diseases* will provide a wide range of laboratory skills at the molecular, cellular, organ, and whole body levels, including analysis of oxidative stress, inflammation, advanced gene/cell therapy and drug delivery techniques for heart and vascular repair, etc. These techniques allow students to investigate the organism aging process and mechanisms of age-related diseases such as heart failure and vascular dysfunction in an integrative manner. The course will also emphasize how to formulate a scientific concept and/or hypothesis, and how to design a research project scientifically.

The course *Concepts and approaches in metabolic phenotyping, anti-obesity targeting and hypoxia research* **(SME.07209)** will present the complex gene-environment interactions in obesity and the challenges in the field of 'phenotyping': What to phenotype? How to phenotype? When to phenotype? These fundamental questions will be addressed in this course with particular emphasis on recent advances and emerging concepts about phenotyping for early metabolic predictors of obesity in view of developing effective strategies for both the prevention and treatment of obesity and associated cardiometabolic risks. In addition, the theory and practice of hypoxia research methods and techniques in cell biology and specific animal (disease) models will be presented.

The *Section of medicine research* **(SME.07210- SME.07211)** seminar series consists of a mixture of internal progress reports by principal investigators and senior scientific collaborators, as well as lectures given by external speakers from Switzerland and abroad. The series covers the three main research areas pursued at the Section of medicine: i) neurosciences, ii) cardiovascular and metabolism, iii) infection, inflammation and cancer. Students have the opportunity to meet with external speakers before or after the lecture.

The *Joint research group meetings of Dept OMI* **(SME.07213)** allows students to present their projects and work progress reports in front of the members of the OMI department. The OMI group meetings are organized every two weeks.

The *Research Day in Medicine* **(SME.07212)** consists of presentations from researchers at the University of Fribourg and the Cantonal Hospital of Fribourg and invited external speakers. Research approaches in basic as well as applied clinical research are covered with the perspective of encouraging collaborative initiatives. Each year a novel topic is proposed among the fields represented in Fribourg. A poster session for students is part of the event.

In the *Cancer/inflammation research journal club* **(SME.07214)** researchers and students report and debate recently published articles. *Research group meetings* **(SME.07603)** allow members of a research group to present and discuss their ongoing work. *Project design in infection, inflammation and cancer* **(SME.07604)** allows the student to carry out a short-term experimental and theoretical project in a research group. He/she can become familiar with investigation methods, learn how to collaborate efficiently with other group members and contribute actively to research. On successful accomplishment of the project he/she will be able to independently deal with new topics and will make the transition towards Masters level research with confidence.

During the *Master's thesis* (**SME.07800)** the student familiarizes herself/himself with modern techniques and executes a research project under the guidance of a group leader within a Cancer/Inflammation research group of the Section of Medicine. This work requires designing and carrying out a research strategy, keeping a clear lab journal and data analysis. The Master thesis also includes a report written like a scientific article (summary, introduction, methods, results, discussion, references).

2.2.5 Courses of the *Tissue Degeneration and Regeneration* option

The course *Cellular immunology: theory and practice* **(SME.07201)** is a balanced combination between theory and laboratory-based practical activities. The students will elaborate themselves the basic principles of immune cell types, cell characterization, cell activation and function. In parallel, laboratory protocols corresponding to the theoretical principals will be applied under the instruction and supervision of experienced researchers. There will be emphasis on experimental design, leading to performing corresponding experiments by the students. The students will collect individual results for each experiment, to be used for statistical analysis and discussion.

Hot topics in Cancer research, Metabolic health and Regenerative biomedicine **(SME.07215)**, comprises a selection of current topics at the forefront of biomedical research presented by experts in each field. Topics vary each year and usually include, among others, cancer immunotherapy, biomarkers in cancer, vaccines, oxidative stress, tissue fibrosis, regeneration and nanomedicine. The course consists of overview lectures, scientific workshops, and demonstrations in the lab. Students will gain insights into some of the hottest and rapidly evolving research topics in the field as well as experience in critical discussion of emerging scientific questions.

The course *Principles and methods in investigating and treating age-associated heart and vascular diseases* **(SME.07203)** will provide a wide range of laboratory skills at the molecular, cellular, organ, and whole body levels, including analysis of oxidative stress, inflammation, advanced gene/cell therapy and drug delivery techniques for heart and vascular repair, etc. These techniques allow students to investigate the organism aging process and mechanisms of age-related diseases such as heart failure and vascular dysfunction in an integrative manner. The course will also emphasize how to formulate a scientific concept and/or hypothesis, and how to design a research project scientifically.

The course *Concepts and approaches in metabolic phenotyping, anti-obesity targeting and hypoxia research* (**SME.07209)** will present the complex gene-environment interactions in obesity and the challenges in the field of 'phenotyping': What to phenotype? How to phenotype? When to phenotype? These fundamental questions will be addressed in this course with particular emphasis on recent advances and emerging concepts about phenotyping for early metabolic predictors of obesity in view of developing effective strategies for both the prevention and treatment of obesity and associated cardiometabolic risks. In addition, the theory and practice of hypoxia research methods and techniques in cell biology and specific animal (disease) models will be presented.

The *Joint research group meetings of Dept EMC (Endocrinology, Metabolism and Cardiovascular System)* (**SME.07104)** will be organized either by our cluster or in collaboration with other universities. It is intended to make students familiar with current frontiers in regenerative biology, cardiovascular and metabolic health research. The course is given by national and international experts working in this field. The students are required to write a short summary (about 2 pages) about the most relevant findings related to their research field presented during the meeting or present their own work as a poster at the meeting.

The course *Research symposium* **(SME.07102)** in *Tissue Degeneration and Regeneration* option will be organized to address the very specific research questions or new research topics that the research groups intend to investigate. Internal and external experts will be invited to discuss the themes. The aim of this course is to discuss the specific questions or topics deeply and to strengthen or establish collaborations among the research groups on specific projects. Students will learn how to critically discuss scientific questions and how to establish scientific collaborations.

The *Research Day in Medicine (***SME.07212)** consists of presentations from researchers at the University of Fribourg and the Cantonal Hospital of Fribourg and invited external speakers. Research approaches in basic as well as applied clinical research are covered with the perspective of encouraging collaborative initiatives. Each year a novel topic is proposed among the fields represented in Fribourg. A poster session for students is part of the event.

In the *Tissue Degeneration and Regeneration journal club* **(SME.07105)** researchers and students report and debate recently published articles. *Research group meetings* allow members of a research group to present and discuss their ongoing work. *Project design in Tissue Degeneration and Regeneration* **(SME.07608)** allows the student to carry out a short-term experimental and theoretical project in a research group. He/she can become familiar with investigation methods, learn how to collaborate efficiently with other group members and contribute actively to research. On successful accomplishment of the project he/she will be able to independently deal with new topics and will make the transition towards Masters level research with confidence.

During the *Master thesis* **(SME.07800)** the student familiarizes herself/himself with modern techniques and executes a research project under the guidance of a group leader within a *Tissue Degeneration and Regeneration* research group of the Section of Medicine. This work requires designing and carrying out a research strategy, keeping a clear lab journal and data analysis. The Master thesis also includes a report written like a scientific article (summary, introduction, methods, results, discussion, and references).

2.3 MSc exams and assessment

Assessment criteria for UEs are specified in the appendices to the curriculum in Medical sciences, morphology, and physiology. The UEs of the Master courses (compulsory, elective and relative to the options) and Master thesis-related activities are collectively assessed in the first validation package, and accords the student 60 ECTS credits, if successful.

2.4 Master's thesis and exam

The second validation package of the Master's programme (60 ECTS credits) consists entirely of the UE dedicated to the *Master's thesis* itself (SME.07800). This work is foreseen to be completed within 18 months. It is laboratory-based research work that the student will carry out under the supervision of an active researcher in the field, and during which the student's aptitude for fundamental and biomedical research will begin to develop. The work will be presented both as a formal written document, and as a 30-minute oral presentation. The work will be evaluated on the same scale (1, unacceptable to 6, excellent) as the exams. The second validation package will be validated only for marks of 4 and above. If a work is judged insufficient, a second Master thesis project may be offered to the student.

Successful completion of the two validation packages results in the right to the title **Specialised Master of Science in Experimental Biomedical Research**, **option "Neuroscience", "Infection, Inflammation and Cancer"** or **"Tissue degeneration and regeneration"**, **University of Fribourg (sp-MSc)**.

2.5 Admission regulations for the Master's programme

To be admitted to the Master's programme, students must fulfil the University admission requirements, as defined in the *Règlement concernant l'admission à l'Université de Fribourg* (https://www.unifr.ch/apps/legal/fr/document/274904).

The number of students accepted is limited to the training capacities of the Section of Medicine. Candidates should submit a complete application that includes the following documents:

- Bachelor degree diploma in biology, biochemistry, biomedical sciences or medicine (original or certified copy).
- Transcript of records.
- Description of their Bachelor's studies (for applicants coming from Universities other than Fribourg), including information about the content and volume of the courses.
- Motivation letter, in which the applicant should also specify her/his preferred option (specialisation) in the Master programme.
- One or two letter(s) of recommendation from an academic professional. The referee should specify in which capacity he/she has formed an expert opinion of the applicant.

The applications will be evaluated and selected candidates may be invited for an interview. The selection criteria for the evaluation are the academic performance during previous academic studies, the motivation for pursuit of studies in the Master's programme and the content of the recommendation letter(s).

3. Appendix: Table summarizing all master courses

The Course units are shown as O (Obligatory), E (Elective), - not possible
Options are:

RCM = Tissue Degeneration and Regeneration
IIC = Infection, Inflammation and Cancer
N = Neuroscience

Code	Title of the Course Unit	ECTS	TDR	IIC	N	Prerequisites / Comments
SME.07010	Basic knowledge upgrading	1	O	O	O	
SME.07100	Models for human diseases	3	O	O	O	
SME.07200	Infection, inflammation and cancer	3	O	O	O	
SME.07300	Central nervous system regeneration and repair	3	O	O	O	
SME.07400	Microscopy in life sciences	3	O	O	O	
SME.07502	Advanced scientific writing	3	O	O	O	
SME.07700	Data analysis and statistics with the R programming language	3	O	O	O	
SME.07501	Scientific communication	3	O	O	O	
SME.07701	Introduction to modern instrumentation	3	O	O	O	
SBL.00427	Visual communication of data	1	O	O	O	Biology
SBL.10004	Ethics in stem cell research	1	O	O	O	Biology
SBL.00420	Career profiling in life sciences	1	E	E	E	Biology / Every 2 years
No code	English for Master Students of Science I	3	E	E	E	Biology
No code	English for Master Students of Science II	3	E	E	E	Biology
SBL.00115	The RNA world	1.5	E	E	E	Biology
SBL.00419	Advanced imaging	1	E	E	E	Biology
SBL.00451	Introduction to mass spectrometry and proteomics	1	E	E	E	Biology / SBL.00451 and SBL.00452 must be taken together. contact Dept. of Biology
SBL.00452	Advanced quantitative proteomics	1	E	E	E	
SBL.00119	Molecular genetics of model organism development	3	E	E	E	Biology SBL.00119, SBL.10001 and SBL.10002 must be taken together.
SBL.10001	Modelling human disease in experimental genetic systems	2	E	E	E	
SBL.10002	From bench to bedside	0.5	E	E	E	
SBL.00428	Optogenetics	1	E	E	E	
SCH.05123	Innovation and Entrepreneurship	4	E	E	E	
SME.07800	Master thesis	60	O	O	O	
Course Units in the Neuroscience						
SME.07301	Behavioural methods in neuroscience	3			O	
SME.07305	From neurons to culture and back	3			O	
L25.00721	Sleep and visual neuroscience [L071.0821]	3			O	
L25.00644	Introduction to Matlab I [L071.0743]	3			O	
Thesis-related activities in the Neuroscience option						
SME.07002	Fribourg day of cognition	0.5			O	
SME.06001	Neurobiology (seminar)	0.5			O	
SME.07001	Neurobiology (seminar)	0.5			O	
SME.07306	Frontiers in neuroscience BENEFRI (workshop)	0.5			O	
SME.07307	Neuroscience journal club [2 semesters x 18 h]	4			O	
SME.07609	Research group meetings in Neuroscience [3 semesters x 18 h]	4.5			O	
SME-07602	Project design in Neuroscience	4.5			O	
Course Units in the Infection, Inflammation and Cancer option						
SME.07201	Cellular immunology: theory and practice	3	O	O		
SME.07215	Hot topics in cancer research, Metabolic Health and regenerative biomedicine	3	O	O		
SME.07203	Principles and methods in investigating and treating age-associated heart and vascular diseases	3		O		

SME.07209	Concepts and approaches in metabolic phenotyping, anti-obesity targeting and hypoxia research	3		O		
Thesis-related activities in the Infection, Inflammation and Cancer option						
SME.07210	Section of medicine research (seminar)	0.5		O		
SME.07211	Section of medicine research (seminar)	0.5		O		
SME.07213	Joint research group meetings of Dept OMI (Oncology, Microbiology and Immunology)	0.5		O		
SME.07212	Research Day in Medicine	0.5	O	O		
SME.07214	Cancer/inflammation research journal club [2 semesters x 18h]	4		O		
SME.07603	Research group meetings in cancer/inflammation [3 semesters x 18h]	4.5		O		
SME.07604	Project design in cancer/inflammation	4.5		O		
Course Units in the Tissue Degeneration and Regeneration option						
SME.07203	Principles and methods in investigating and treating age-associated heart and vascular diseases	3	O			
SME.07209	Concepts and approaches in metabolic phenotyping, anti-obesity targeting and hypoxia research	3	O			
SME.07201	Cellular immunology: theory and practice	3	O	O		
SME.07215	Hot topics in cancer research, Metabolic Health and regenerative biomedicine	3	O	O		
Thesis-related activities in the Tissue Degeneration and Regeneration option						
SME.07104	Joint research group meetings of Dept EMC (Endocrinology, Metabolism and Cardiovascular System)	1	O			
SME.07212	Research Day in Medicine	0.5	O	O		
SME.07102	Research symposium	0.5	O			
SME.07105	Tissue Degeneration and Regeneration journal club [2 semesters x18h]	4	O			
SME.07607	Research group meetings in Tissue Degeneration and Regeneration [3 semesters x 18h]	4.5	O			
SME.07608	Project design in Tissue Degeneration and Regeneration	4.5	O			