First year courses

Bachelor RMT Year 1

Fac. Health, Medicine and Life Sciences

The Molecular Basis of Life

Full course description

The course 'The Molecular Basis of Life' relies on the students' existing knowledge and understanding of biology and chemistry. It aims to provide insight into the structure and function of living and non-living matter. New concepts are introduced in the context of regenerative medicine and directly applied in solving problems and addressing challenges in the field. The period partly focuses on the structure and function of living tissues. The emphasis is on how cells interact with biologically relevant molecules, such as growth factors and extracellular matrix molecules, and how their interplay determines tissue development and homeostasis. The role of stem cells and their potency will be introduced in the context of these processes. Distinctions are made between several cell types and tissues (bone, cartilage) that highlight the structure-function relationship. Basic chemistry concepts are introduced in a biological context. Students are trained in applying key concepts of organic, inorganic and physical/analytical chemistry, such as stability, reactivity, functional groups, reaction/mechanism types, structure, kinetics, thermodynamics, and chemometrics to understand complex biological systems as well as to design materials for biomedical applications. The newly taught concepts are integrated in multidisciplinary cases/problems, which are discussed and worked out in small groups.

Course objectives

1. Elaborate how matter is built, which chemical bonds and supramolecular interactions can be present in matter as well as the molecular and physical differences between gases, liquids, solids and solutions;
2. Describe the concepts of acids and bases, nucleophiles and electrophiles, the reactivity of functional groups and their most important chemical reaction types.
3. Explain the interaction between cells and their extracellular environment (natural or synthetic) and cells.
4. Explain the key concepts of cell biology and the corresponding biochemistry that lead to cell proliferation, differentiation, homeostasis and cell death.
5. Explain the structure and functioning of proteins, nucleic acids, carbohydrates, lipids and other biologically relevant molecules.
6. Explain how tissue build-up relies on precise spatiotemporal regulation.
7. Present and discuss the breakdown of tissue properties to chemical, cellular and signal composition.
8. Apply the working principles of regeneration (e.g. cells, signals and scaffolds) in various cases.
9. Explain the laws of thermodynamics, the principles of chemical kinetics and the differences between the thermodynamic and kinetic control of reactions, and understands and applies the very basics of chemo metrics in analytical and physical chemistry (errors, significant figures,

signal to noise ratios, accuracy vs precision).

10. 10Elaborate how the learned basic concepts of general, physical, organic and inorganic chemistry can be applied to understand biological processes and to design materials for biomedical applications with specific physico-chemical properties.

Recommended reading

This is the link to Keylinks, our online reference list.

RMT1001
Period 1
4 Sep 2023
27 Oct 2023
Print course description
ECTS credits:
8.0
Instruction language:
English
Coordinators:

- G.G.H. van den Akker
- J. Bauer

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, PBL, Presentation(s)
Assessment methods:
Assignment, Presentation, Written exam
Keywords:
regeneration, stem cells, chemistry, biology, Biochemistry
Fac. Health, Medicine and Life Sciences

Foundations of Engineering

Full course description

The Foundations of Engineering runs over a period of 8 weeks in period 2 and the course is worth 8 ECs.

The content of this course will also overlap and emphasize the activities within the Lab Skills line, aligning the timing of specific lab activities with the associated theoretical content taught in this course.This also provides a crucial basis for the clinical design project, with coordination with this longitudinal line such that relevant examples are used to teach content within this course that also connects with the clinical orientation of the projects. This course is designed to have students comprehend and transcend different traditional disciplines (maths, physics, engineering) within a regenerative medicine focus so they can derive unique solutions based on fundamental principles. This course will focus heavily on framing the more fundamental topics within an applied setting, specifically providing a context for mathematical concepts and showing why they are relevant to describe the underlying physics involved, and then how to translate this knowledge to solve real world problems. and 2) how to take these concepts into account when addressing practical engineering problems and implementing design approaches. This course will: 1) introduce students to fundamental physics concepts and teach students with the mathematical tools to describe physical

phenomena;

Course objectives

Upon completion of the course, the RMT student is able to:

- Represent a static physical system in terms of a vector diagram and derive a governing equation based on fundamental principles (ie force, acceleration, velocity, etc.) (SE.5)
- Mathematically derive a description of a time-dependent system, including differential equations, integration, and sinusoidal waveforms (SE.5)
- Apply system of equations and polynomial operations to simplify and resolve a physical system description (SE.5)

the RMT student will also be able to:

- Define stress, strain, and the underlying principles of Mechanics of Materials within the context of human biomechanics (SE.7)
- Define rheology, describe shear stress and shear strain and provide an explanation for rate loading dependent phenomenon (SE.7)
- Describe the working principles of analog electronic components and derive the operation of a basic (L)CR circuit (SE.7)
- State the laws of motion, describe the underlying phenomenon and derive their mathematical equations (SE.7)
- Describe, in practical terms, the underpinnings of thermodynamics, fluid dynamics, and mass transfer (SE.7)
- Define (electro)magnetic radiation (SE.7)
- Understand and use computer aided design and finite element modeling (SE.7)

These learning goals fall under the following final qualifications of the Bachelor RMT:

- Scientist & Engineer (SE.5): Has knowledge and understanding of the basic concepts of mathematics and statistics, necessary to apply and develop technology for applications in regenerative medicine.
- SE.7: Has knowledge and understanding of the basic concepts of physics, engineering and materials science, necessary to apply and develop technology for applications in regenerative medicine.

Recommended reading

This is the link to Keylinks, our online reference list.

RMT1002
Period 2
30 Oct 2023
22 Dec 2023
Print course description
ECTS credits:
8.0
Instruction language:
English
Coordinators:

Bachelor Regenerative Medicine and Technology

- C.M. Domingues Mota
- P.A. Wieringa

Teaching methods:
Assignment(s), Lecture(s), PBL, Presentation(s)
Assessment methods:
Attendance, Presentation, Written exam
Keywords:
mathematics, Physics, Movement, Interfaces, Dynamic systems, Modeling, Thermodynamics, Rheology
Fac. Health, Medicine and Life Sciences

Regenerative Medicine in Society

Full course description

years, as well as propaedeutic to the longitudinal lines of the overall Bachelor. The course will give the students an idea of the scope of the field and the wide range of possible applications.rd and 3ndThe objectives of the course "Regenerative Medicine in Society" are to introduce students to classic and novel concepts at the base of strategies to regenerate tissues and organs. In this course, students will learn more about the broad definition of Regenerative Medicine (RM) and its application areas with an emphasis on translation and valorization. The content will focus on the history, current practice and challenges in the RM field as illustrated by the R3-paradigm: replacement, regeneration, and rejuvenation, which constitute the general strategy triad in RM. These three strategies can be employed to achieve the central goal in RM, namely tissue or organ repair. In addition, this course aims to provide the basic knowledge for the more advanced courses of the Bachelor progamme of 2

The historical development of RM will be illustrated based on these three strategies from several medical specialties. Each week of the course will focus on another medical specialty (application). A clinician or researcher specialized in the field will introduce the topic and provide historical RM examples from their respective fields. In addition, ethics of regenerative medicine applications will be discussed in the final lecture, where an open debate with the students will be also stimulated to assess their understanding of the learning objectives and provide further input on the RM cases dealt with in the lectures and tutorials.

We foresee to have additional educational material in the form of video lectures on topics that are instrumental to understand the fundamental principles of regenerative medicine and that will help the students to better understand the lectures and to get prepared for the tutorials. The additional educational material will be a way to further refresh more basic concepts seen in previous courses, yet placed in the application perspective now, namely briefly overviewing cell sources and cell nutrition, the biomaterial classes used to fabricate scaffolds, the processing technologies used for fabrication. Different applications will be further introduced as case studies and RM solutions proposed and discussed by the students in the tutorials (2 tutorials per case study, thus providing a first intake brainstorming case and a second solution case), spanning from neural to organ regeneration.

Course objectives

The course objectives are defined based on the following intended learning outcomes (ILOs):

Bachelor Regenerative Medicine and Technology

- ILO 1. Understands historical perspectives in regenerative medicine in terms of requirements and challenges illustrated by successes and failures
- ILO 2. Understand the 3R-paradigm of Regenerative Medicine: Replace, Regenerate, Rejuvenate
- ILO 3. Understands the key elements that constitute an innovation in regenerative medicine

Recommended reading

Blitterswijk, Clemens A. van and Jan de Boer. 2022. Tissue Engineering. 3rd ed. Amsterdam: Academic Press. Atala, Anthony, R. P. Lanza, Antonios G. Mikos, and Robert M. Nerem, eds. 2019. Principles of Regenerative Medicine. Third ed. London, U.K.: Academic Press, an imprint of Elsevier.

RMT1003
Period 3
8 Jan 2024
2 Feb 2024
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- L. Moroni

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, PBL
Assessment methods:
Attendance, Written exam
Keywords:
Regenerative Medicine; Cells; Biomaterials; Scaffolds; Biofabrication; Biological factors; Cell Signaling Pathways
Fac. Health, Medicine and Life Sciences

Principles of Medicine

Full course description

At the end of the course the student will have basic knowledge of anatomy and physiology of the major organ systems and processes also described in the field of regenerative medicine to understand the normal anatomy/physiology versus pathology and a start for understanding regenerative medicine as potential therapy.

Learning Goals:

1. Describe the basic principles and nomenclature of the anatomy of the human body.
2. Outline the organ systems often targeted in regenerative medicine
3. Demonstrate basic knowledge of physiological and pathological inflammation
4. Integrate basic principles foreign body responses and transplant immunology
5. Synthesize basic knowledge of wound healing and vascularization

Bachelor Regenerative Medicine and Technology

RMT1004
Period 4
5 Feb 2024
5 Apr 2024
Print course description
ECTS credits:
8.0
Instruction language:
English
Coordinator:

- C.H.M.J. van Elssen

Teaching methods:
Lecture(s), Work in subgroups, PBL, Skills, Training(s)
Assessment methods:
Participation, Portfolio, Written exam
Keywords:
Physiology, anathomy, immunology, vascularisation, nervoussystem, gastrointestinal system, cardiopulmonary system
Fac. Health, Medicine and Life Sciences

Coding and Data Crunching

Full course description

This course teaches the basics of scripting, data analysis and statistics. Statistical tools for modern data analysis are used across a range of industries to help guide organisational, societal and scientific advances. This course uses the software package R for numerical reasoning and predictive data modelling, with an emphasis on conceptual rather than theoretical understanding. Topics include description of populations, distribution of data, inferential statistics (based on simple tests such as t- and chi-square tests), introduction to linear regression analysis and concept of probability (including Bayes' rule, disjoint and independent events (multiplicative rules), law of total probability). These will be introduced in cases related to regenerative medicine.

To apply the theoretical statistics concepts, students will become familiar with general concepts in computer science, gain an understanding of the general concepts of programming, and obtain a solid foundation in scripting. The cases used in the programming activities will be related to regenerative medicine. This course is envisioned as an introduction to scripting; its goal is that students learn how to handle data sets and to automate the analysis thereof using a programming language. The students will learn to plan and think carefully about why a particular analysis is needed, what should be done etc. before starting to write the script. Topics include basic control structures, graphical data presentation, biomedical data handling (including legal and ethical aspects thereof). Additionally, this course will contribute highly to the personal development line of the students with focus on problem solving.

Course objectives

Aim and learning methods:

Bachelor Regenerative Medicine and Technology

This course will be application-driven and you will learn the necessary theory in lectures while also focusing on hands-on exercises in computer practicals, problem based coding and pen & paper seminar sessions to learn how to analyse the data and represent it in a correct way in the context of regenerative medicine. In the group project you will have the chance to train and demonstrate your skills in R programming and statistics on one large dataset.

Recommended reading

No specific text book - any works on statistics and R programming language is suitable

RMT1005
Period 5
8 Apr 2024
7 Jun 2024
Print course description
ECTS credits:
9.0
Instruction language:
English
Coordinators:

- F. Ehrhart
- B. Spronck

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, PBL, Presentation(s), Skills, Training(s)
Assessment methods:
Assignment, Attendance, Computertest, Participation, Presentation
Keywords:
statistics, programming, data analysis, R (programming language)
Fac. Health, Medicine and Life Sciences

The Intrinsic Regenerative Capacity of the Human Body

Full course description

In the course “The Intrinsic Regenerative Capacity of the Human Body”, students will complement their obtained knowledge on biology and medicine as they are exposed to the ability the human body has to regenerate. Defects due to injuries or diseases disrupt tissues. Many tissue and organs possess an endogenous ability to regenerate. For example, skin, bone, and gut all have the ability to heal after injury in case the defects are not too large. Conversely, some tissues like the heart have a very low capacity to regenerate. Studying the biological mechanisms underlying endogenous healing will lead to an improved understanding of what we aim to mimic in regenerative medicine. Thereby, the students will learn that there is a tissue-dependent wound healing with different time scales and degrees of regeneration. Resident differentiated cells and stem cells moderate these processes and the translation to their usage in regenerative medicine therapies is envisioned. The role of inflammation is also conveyed, besides the importance of vascularization. Within these processes, the concept of functional repair versus complete regeneration will be elucidated as well. This is further discussed in the context of regenerative boundaries (diffusion, signal molecules, cell senescence). These processes depend on patient specific factors such as ageing and co-morbidities.

Course objectives

The learning goals are achieved by different forms of teaching. Each week there will be a knowledge clip instead of a traditional lecture. A one hour Q&A session with the expert providing the knowledge clip is scheduled. During this session, students can ask any doubts and unclarities that exist after having studied the knowledge clip and its content. The information from these knowledge clips is further expanded in two tutorials per week, where cases are discussed. Each tutorial has a pre-discussion and post-discussion. The students should spend time in self-study to prepare for the tutorials.
Below is a table with the time schedule. The below table is for your information only. It is not definitive and is subject to changes. Always check the Student Portal for the exact place and time of the lectures, tutorials, exams, and other deadlines.

Upon completion of the course, the RMT student is able to:

- • Define and explain potential causes and consequence of failed regeneration
- • Elaborate upon the different regeneration potentials of different tissues and why the regenerative potential differs
- • Describe the effect of ageing and other co-morbidities on the regenerative capacity
- • Summarise the intrinsic wound regeneration phases including different scales and important factors
- • Evaluate and reflect upon the limits of regeneration and which factors do contribute to that

Recommended reading

Principles of Regenerative Medicine, Atala et al., Elsevier Tissue Engineering, van Blitterswijk et al., AP Wound healing: Process, Phases and Promoting, Middleton, Nova Biomedical

RMT1006
Period 6
10 Jun 2024
5 Jul 2024
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- M. van Griensven

Teaching methods:
Work in subgroups, Lecture(s)
Assessment methods:
Written exam
Keywords:
healing stem cells time scale regeneration vs repair senescence
Fac. Health, Medicine and Life Sciences

Academic Development Line Year 1

Full course description

Next to the clinical design project and the lab skills line, the academic development line (ADL) is one of longitudinal lines in the RMT programme. ADL deals with the following general competences: knowing yourself, understanding what acceptable standards and values are, being able to express yourself, organise your study and work, and building relations. The activities in the academic development are subsumed under four competency domains:

1. **Self-regulated learning skills.** These skills will help students to develop adequate learning strategies (Study Smart Training) and find their way in the ever-growing data and information jungle (Information Literacy);
2. **Professional behavior.** Within this domain, students will become aware of their personal behaviour in teams and how this will affect the functioning of that team and its other members. As a future professional and global citizen, working in teams will be an important skill;
3. **Scientific storytelling.** In this domain, students will learn how to share and communicate their results, visions, etc. both in writing and in oral to a specific audience or readership, which includes fellow students, teachers and peers;
4. **Personal development.** To help students finding and developing their personal path in the wealth of opportunities that RMT is offering, the ADL contai

Course objectives

Self-regulated learning skills.

- Be able to reflect on personal learning strategies;
- Be able to reflect on planning and management of study;
- Be able to appreciate the presence of refresher courses and be able to argue whether or not they need to follow (parts of) them;
- Be able to appraise the various topics and specializations of RMT;
- Be able to reflect on following the steps of a Creative Problem Solving (CPS) approach (or something similar) when dealing with new challenges.

Professional behavior

- Be able to show awareness of different roles and their function in a diversely composed team; provides feedback;
- Be able to identify with appropriate social behaviour towards peers and staff;
- Be able to describe the conventions of scientific integrity and ethical standards.

Scientific storytelling

- Be knowledgeable of the different formats scientific research can be written in and be capable of writing the different sections of a scientific report;
- Be knowledgeable of different ways to present information and be able to put this into practice by presenting information (e.g. learning goals, summary within tutorial group or project) with the support of slides.

Personal development

- Be able to accept feedback and be able to critically reflect on their learning;
- Be able to formulate SMART learning goals – with help of mentor - in order to take adequate action with a view to raising the student's competencies up to the desired level.

Recommended reading

This is the link to Keylinks, our online reference list.

RMT1101
Year
1 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
8.0
Instruction language:
English
Coordinator:

- D.G.J. Jennen

Assessment methods:
Assignment, Attendance, Participation, Portfolio
Keywords:
Self-regulated learning skills Professional behavior Scientific storytelling Personal development
Fac. Health, Medicine and Life Sciences

Lab Skills Line Year 1

Full course description

The practical skills longitudinal line is one of the three longitudinal lines, and runs through the first two years, as Laboratory Skills I (year 1) and Laboratory Skills II (year 2), each worth 7 ECs. Lab skills trainings are mainly concentrated in the 8-week periods, in which the experiments are aligned with the content of the courses. Every 8-week course, students need to demonstrate sufficient skills in preparing experiments (preparing the practical, performing lab-related calculations) and carrying them out, keeping a lab journal, and basic lab skills (weighing, pipetting, etc.). As the practical sessions are all part of the lab skills line, repeated practice of skills, with increasing degree of complexity throughout the bachelor is achieved, and longitudinal tracking of development of lab skills is possible. Importantly, students will also be able to practice and further develop their practical skills in a self-directed manner within the design project; this is aligned with the lab skills line.

Students receive regular formative feedback by staff and peers on these skills, which will be added to the portfolio at the end of each 8-week course. Next to this, students are assessed on their performance by means of a summative practical exam consisting of two parts (in periods 3 & 6 each year). The lab skills line formally ends at the end of year 2.

Course objectives

- Be able to work according to principles of GLP and GMP, safely work with chemicals, and work in sterile environment
- Be able to do lab calculations, and implement these in combination with basic lab skills
- Be able to synthesize and purify a product, follow reaction kinetics, and know how to steer a chemical reaction
- Be able to measure receptor-ligand and cell-cell interactions in biological experiments
- Be able to apply knowledge and understanding of mathematical and physics problems in designing, executing, and interpreting experiments
- Be able to apply sensors, computer modelling, and 3D printing for designing and interpreting experiments
- Be able to examine and analyze tissues based on anatomy, clinical imaging & microscopy, pathology, and measure functional parameters in these tissues
- Be able to work with and show skills for working with lab journal and SOPs
- Be able to apply analysis and visualization of data (Course 1.5)
- Be able to apply statistics to experimental data and report on experimental data

RMT1102
Year
1 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinators:

- T. Rademakers
- C.M. Domingues Mota

Teaching methods:
Assignment(s), Skills, Training(s)
Assessment methods:
Attendance, Observation, Participation, Presentation
Fac. Health, Medicine and Life Sciences

Orientation Design Project

Full course description

The aim of this project is for students to experience the full research and development cycle from analysing a clinical problem / identifying potential solutions / techniques to address the problem, conducting (clinical) research and developing (part of) a new clinical application/device/material/therapy themselves. An orientation on -and preparations for the conduct of- the design project will be launched in year 1. During the first year, students visit research labs and interview experts being clinicians and scientists involved in regenerative medicine (working in hospital, labs, industry). Moreover, ample attention in the year 1 ‘design project orientation’ will be provided to gain insight in examples of clinical applications in regenerative medicine and to learn how these applications have travelled and will travel ‘from bench to bed’ and have been

implemented ‘into the market’. This will also be achieved by doing journal clubs where specific articles on the themes of the experts interviewed are scrutinized to enhance the student’s understanding. This line interacts closely with the academic line and the practical skills line.

The Design Project line’s main activities in year 1 are therefore:

- Interview with expert
- Site visits (partially in combination with visiting the expert)
- Journal clubs
- Project pitch after choosing the expert/project

The (orientation on) the design project line thus introduces aspects of entrepreneurship & marketisation and encompasses an initial labour market orientation. At the end of year 1, the students select a project to work on in year 2. There are two main project orientations which students can choose from; a clinical or technological track. In the clinical track, the students interact with an expert from the clinic on a direct clinical problem. In the technological track, the students perform their project in an academic laboratory setting or in an industrial research & development setting. The projects of both tracks are on designing a regeneration project, but the emphasis is different depending on the expert.

Course objectives

The learning goals will be achieved through expert interviews, journal clubs, and designing the project to be carried out in year 2.

After this the student:

- Is able to independently apply relevant laboratory skills and techniques to conduct research in regenerative medicine.
- Understands, appreciates and critically assesses the process of scientific research to obtain academic knowledge and insight, and is able to draw conclusions based on evidence in a logically structured fashion.
- Readily evaluates, selects and applies scientific methodology and available technology to address current challenges and problems in regenerative medicine or in a related biomedical field, and contributes to finding an innovative solution.
- Based on obtained research results or applied technologies, contributes to the realisation of novel, innovative and marketable clinical or biomedical products/therapies.
- Organises study, work and research efficiently and effectively, and within given time constraints.
- Shows awareness of various team roles, functions efficiently in multidisciplinary and otherwise diverse teams, values diversity in a broader sense, and takes into account ethical standards and societal, economic and regional and global contexts.

Communicates professionally and adjusts style and type of communication and argumentation to the audience and the occasion.

Recommended reading

This depends on which expert is interviewed. But examples of papers are: Eur Cell Mater.

2020;39:183-192. doi: 10.22203/eCM.v039a12. Enhancement of fracture healing after citrulline supplementation in mice D M Meesters , P F Hannemann, H M van Eijk, V T Schriebl, P R Brink, M Poeze, K A Wijnands (Trauma Surgery) PLoS One 2020;15(10):e0241296. doi: 10.1371/journal.pone.0241296 A comparison of the corneal biomechanics in pseudoexfoliation glaucoma, primary open-angle glaucoma and healthy controls using Corvis ST Zia Sultan Pradhan, Sujit Deshmukh, Shivani Dixit, Shruthi Sreenivasaiah, Sujani Shroff, Sathi Devi, Carroll A B Webers, Harsha Laxmana Rao (Opthalmology) Sci Rep 2019;9(1):12076. doi: 10.1038/s41598-019-48369-w. Electrical stimulation promotes the angiogenic potential of adipose-derived stem cells Jip Beugels, Daniel G M Molin, Daan R M G Ophelders, Teun Rutten, Lilian Kessels, Nico Kloosterboer, Andrzej A Piatkowski de Grzymala, Boris W W Kramer, René R W J van der Hulst, Tim G A M Wolfs (plastic surgery and pediatric research) Sci Rep 2021;11(1):19663. doi: 10.1038/s41598-021-99096-0. BMP7 reduces the fibrocartilage chondrocyte phenotype Ellen G J Ripmeester, Marjolein M J Caron, Guus G H van den Akker, Jessica Steijns, Don A M Surtel, Andy Cremers, Laura C W Peeters, Lodewijk W van Rhijn, Tim J M Welting (cartilage research) Control Release 2011;152 Suppl 1:e10-1. doi: 10.1016/j.jconrel.2011.08.090. Amino acid based polyesteramides and polyesterurethanes: cell responsive matrices for drug delivery Aylvin A Dias, Bart Plum, G Mihov, Bill Turnell (company DSM)

RMT1103
Year
1 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
4.0
Instruction language:
English
Coordinator:

- M. van Griensven

Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Working visit(s)
Assessment methods:
Presentation
Keywords:
clinical problem research problem industry problem planning designing
Fac. Health, Medicine and Life Sciences

Attendance Lab Skills Line Year 1

RMT1112
Year
1 Sep 2023
31 Aug 2024
Print course description
ECTS credits:
2.0
Instruction language:
English
Coordinators:

- T. Rademakers

Bachelor Regenerative Medicine and Technology

- C.M. Domingues Mota