Course Descriptions

Genomics
The aim of the present course is to develop the abilities of student to understand the foundations of genomics and to apply knowledge of genomics to the analysis of the normal and pathological characteristics of a human and to the analysis of the personal genomics.

Data mining
The unit aims at providing the basic concepts of data mining, teaching the students how to explore relevant concepts and sources for further development through theoretical lectures, exercises and case studies. The unit is also oriented towards applying the data analysis concepts on real life biomedical datasets.

GNU/Linux type operating systems
The systems biology course aims to teach students the skills to analyse and critically assess large volumes of biological data. Computers are absolutely necessary to handle such amounts of data efficiently. Currently, most popular and powerful computing systems for data analysis and computer simulations (computer clusters, HPC computers) are based on Unix or GNU/Linux operating systems, and good command of these systems is an essential ingredient for efficient learning and later for productive work in the systems biology field.
The purpose of this module is to acquire the necessary skills in working with GNU/Linux operating systems and to perform tasks necessary for biomedical data analysis using these systems. Students should be able to use command line of the GNU/Linux systems efficiently, combine command line tools with visual GUI programs and to master basic data and computation management skills.

Programming for biological data analysis
The course aims to develop programming skills which are necessary for solving problems in systems biology. This course is based on Python programming language and specialized Python tools for data analysis and visualization. After completing the course, students should be able to (1) apply the skills they have learned to tackle problems in their own research and (2) continue programming learning in a self-directed way.

Multivariate statistics with R
The course introduces statistical methods and underlying concepts for data analysis with a focus on systems biology. The course emphasises modern computational approaches using the statistics software R.
The aim of this course is two-fold: first, students will learn to matrix algebra which will be background for multivariate statistics and mathematical modelling. Second, students will learn standard methods from statistics with application to systems biology datasets of medium complexity. In addition, students should gain a good understanding of the underlying principles and concepts in order to be able to choose from the vast set of available statistical tests and methods and critically employ them.

Human physiology
The main objectives of this course are to teach students about the functions of human organs and systems, including the processes of interaction between different physiological systems and the mechanisms of physiological regulation, in order to achieve the required theoretical basis for further studies.

Genome structure
Students will acquire fundamental knowledge about genome structure and organization in prokaryote and eukaryote organisms, develop understanding of essential principles of genome functioning, maintenance, expression and regulation, attain necessary knowledge and understanding of modern experimental molecular and computational bioinformatics techniques to study genomes, develop skills to understand and interpret outputs of experimental techniques studying genomes, develop an advanced understanding of genome biology necessary to follow systems biology program.

Cell biology
The scope of the course unit is to acquire knowledge on cell structure and function at the molecular level.
The main competence to be developed by this course is to know the signal transduction principles, cell molecular and functional changes in response to it.

Mathematical modelling
The purpose of this course unit is to develop key mathematical skills related to theory of differential equations and its applications in mathematical modeling of dynamics of various biological components as well as to graph theory and optimization and their applications to model and solve problems in systems biology.
The students will be introduced to differential equations including initial and boundary value problems, graph theory and search algorithms on graphs, optimization theory and algorithms. In addition, students should gain a good understanding of the underlying principles and concepts in order to be able to choose proper models and algorithms to solve their problems.

Epigenomics
Students will acquire knowledge about epigenetic regulation of the genome and develop competence to discuss and evaluate scientific arguments in Epigenetics and Epigenomics fields, and analyze experimental data.

Transcriptomics
Aim of this course is to acquire knowledge about transcriptomic regulation of the genome and to develop competences in order to discuss and evaluate scientific arguments in transcriptomics and metabolomics fields, and analyse transcriptomic experimental data.

Proteomics
This course will focus on latest advances in proteome science including cutting-edge proteomic approaches and technologies. Students will acquire the basic and novel methods of sample preparation to proteomic analysis, top-down and bottom-up quantitative label-based and label-free differential proteomics, identification of post-translational modification and subcellular proteome analysis. Major emphasis will be given on proteomic application in basic science of cell biology and clinical research. Student will gain new knowledge in the field of proteome science and will learn how to apply it addressing practical issues of basic and applied science.

Neurobiology
In this course integrating Neurobiology and Neurogenetic students will acquire knowledge on principles and mechanisms of nervous and sensory systems, and foundations of neurogenetics in a human organism, mechanisms of inherited neurological disturbances; develop the abilities to apply knowledge of neurogenetics to the analysis of the normal and pathological characteristics of a human organism.

Mathematical physiology
Ability to describe biological objects by differential equations, make plausible assumptions and analyse solutions obtained.